Section 4

Assessment and Management of Key Environmental Issues

P R E A M B L E

The assessment and management of the key environmental issues identified in Section 3 commences with an outline of background information relevant to a number of the subsequent issues.

For each key environmental issue identified in Section 3.3.2, the existing features are described and the constraint(s) the existing features would have on the design and operation of the Project are identified. The mitigation measures and operational procedures required to manage each issue are then outlined together with the predicted changes to that component of the environment on and/or surrounding the Project Site. Residual impacts are then assessed against statutory criteria or goals or relevant guidelines and/or policies. Where appropriate, a program of monitoring and documentation is proposed to demonstrate the predictions presented in this document are being achieved and compliance criteria or goals satisfied.

The text for the bulk of this section is drawn from studies undertaken by a range of specialist consultants commissioned by the Proponent. Wherever possible, the study results have been summarised focussing only upon the key points. Readers should refer to the relevant part in the Specialist Consultant Studies Compendium in the event further detail is required.

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4.1 BACKGROUND INFORMATION

4.1.1 Introduction

The various assessments of potential environmental impacts throughout this section are reliant upon a range of background information which is common to many of the key environmental issues assessed. The following subsection provides a summary of relevant background information relating to topography, meteorology, land ownership, land uses and surrounding residences.

4.1.2 Topography

The Project Site is located within an elevated region which is part of the greater Oberon Plateau on the western slopes of the Great Dividing Range (see **Figure 4.1**). Elevations across the Project Site range from approximately 1 110m AHD in the south to slightly in excess of 1 210m AHD in the north with elevations within the proposed extraction area ranging between approximately 1 136m AHD to 1 194m AHD (see **Figure 4.2**). The Project Site slopes to the south towards the Duckmaloi River, which is located approximately 50m topographically lower than the lowest part of the Project Site. Natural slopes within the Project Site range between 1:17.5 (V:H) (3°) within the northern parts of the Project Site to 1:1.7 (V:H) (30°) within the southern parts of the Project Site (south of the existing extraction area).

The existing extraction area forms an amphitheatre into the side of the plateau providing topographic shielding to surrounding land located to the north, east and west. In particular, the closest residences to the southwest of the Project Site are located at elevations between 1 070m AHD and 1 100m AHD (ie. between 30m and 120m lower than the proposed extraction area). Due to their proximity to the base of the ridge which rises steeply towards the Project Site, the residences do not have direct line of sight of the proposed activities. It is noted that residences directly south of the Project Site have minimal topographic shielding to the proposed extraction area although they are located at greater distances.

4.1.3 Meteorology

4.1.3.1 Source of Data

The Bureau of Meteorology operates several meteorological stations within the Oberon area, the closest station being the Jenolan Caves Road Station (No. 063293) located approximately 2.4km to the northwest of the Project Site. It is noted that the station is located at approximately the same elevation (1 190m AHD) as the Project Site. The closest available evaporation data was sourced from the Bathurst Agricultural Station (No. 063005).

Additionally, wind and rainfall data was made available to the Proponent by Carter Holt Harvey from a private meteorological station located approximately 9km to the north-northwest of the Project Site. This station is the closest station recording wind data in 15 minute increments. A summary of available meteorological data is provided in **Table 4.1**.

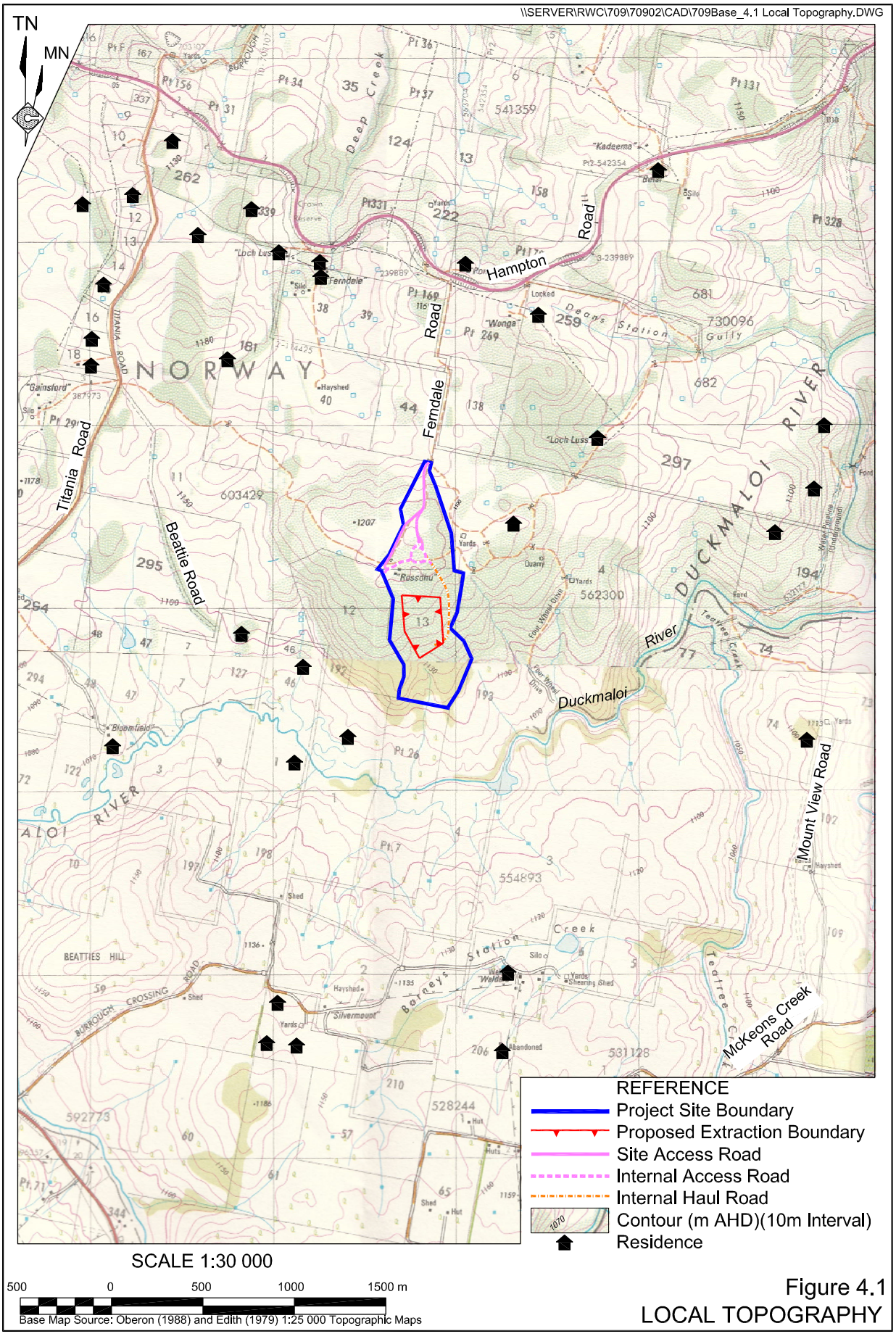


Figure 4.1
LOCAL TOPOGRAPHY

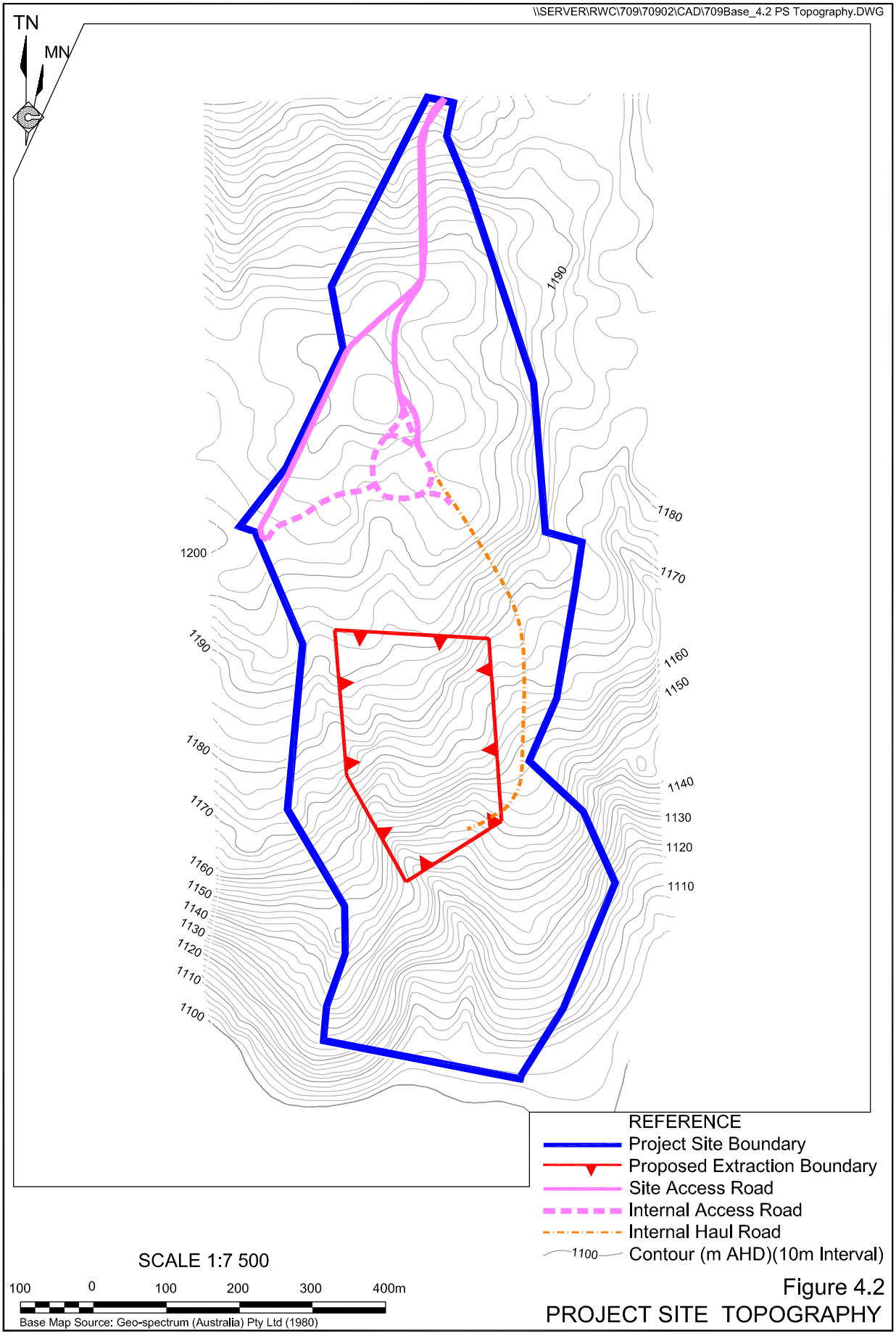


Figure 4.2
PROJECT SITE TOPOGRAPHY

4.1.3.2 Rainfall

As can be seen in **Table 4.1**, the rainfall is relatively evenly distributed throughout the year although peak rainfall occurs during summer and the lowest rainfall occurring during autumn and winter. January is the wettest month receiving on average 85.1mm and April the driest month receiving on average 42.4mm. The average annual is 737.4mm with the average annual number of rain days being 126.5.

Table 4.1
Monthly Meteorological Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TEMPERATURE (°C) - Jenolan Caves Road (Station No. 063293)– 14 years of records													
Mean Maximum	24.0	23.2	20.5	17.1	13.0	9.5	8.4	9.8	12.5	15.5	18.4	22.0	
Mean Minimum	11.9	12.0	9.5	7.0	4.0	1.6	0.5	0.8	3.6	5.8	7.6	10.5	
Lowest	3.9	0.4	0.9	-3.6	-4.0	-4.7	-7.5	-7.5	-7.1	-4.4	-1.6	1.5	
Highest	35.5	35.6	31.2	25.4	20.0	17.4	16.2	18.4	22.2	25.9	33.3	32.5	
Days <2 °C	0.0	0.2	0.5	2.8	7.8	15.2	18.9	17.2	9.6	4.4	2.1	0.1	78.8
RAINFALL (mm) Jenolan Caves Road (Station No. 063293)– 18 years of records													
Mean	85.1	72.8	52.2	42.4	44.4	55.4	60.6	61.9	59.9	57.8	80.6	68.2	737.4
Mean Rain Days	10.3	10.4	8.9	7.3	9.6	12.1	13.6	11.9	12.5	8.9	11.6	9.4	126.5
Highest	205.0	212.9	216.6	227.1	130.8	109.0	108.2	192.2	135.4	186.4	163.0	153.6	1034.2
Lowest	19.4	9.6	4.4	2.4	1.6	0.0	19.0	6.0	10.0	5.6	14.4	10.2	365.0
EVAPORATION (mm) Bathurst Agricultural Station (Station No. 063005) - 36 years of records													
Mean Monthly Pan Evaporation	210.8	162.4	139.5	87.0	52.7	33.0	37.2	55.8	81.0	120.0	161.2	204.6	1350.5
WIND SPEED (km/hr) Jenolan Caves Road (Station No. 063293) – 12 years of records													
Mean 9:00am	10.4	9.8	9.1	10.3	11.2	12.3	13.4	16.3	17.5	15.7	13.6	11.2	
Mean 3:00pm	14.7	13.9	13.6	13.3	13.9	15.4	17.0	20.5	21.4	18.8	17.4	15.0	
RELATIVE HUMIDITY (%) Jenolan Caves Road (Station No. 063293) – 15 years of records													
Mean 9:00am	74	80	81	78	83	87	88	82	77	72	75	73	
Mean 3:00pm	50	55	53	53	63	70	69	62	60	56	58	52	
Source: Bureau of Meteorology													

4.1.3.3 Evaporation

The closest station measuring pan evaporation is Bathurst Agricultural Station (Station 0063005) 48km northwest of the Project Site. **Table 4.1** presents the average monthly evaporation data showing the highest evaporation in January (210.8mm) and lowest evaporation in June (33.0mm). On average, annual evaporation is 1 350mm, a level approximately 1.8 times higher than the average annual rainfall recorded at the Jenolan Caves Road Station. It is noted that average rainfall exceeds evaporation during the months of June to August. For the remaining months, evaporation exceeds rainfall.

4.1.3.4 Temperature

Average daily maximum and minimum temperatures recorded are presented in **Table 4.1**. The Oberon area is generally cool with frosts common in autumn, winter and spring and with several snowfalls generally received each year. Mean daily temperatures range from 0.5°C (minimum) to 9.8°C (maximum) in winter, and from 10.5°C (minimum) to 24.0°C (maximum) in summer. January is the warmest month and July the coldest month.

4.1.3.5 Wind

Figure 4.3 displays both the average annual and seasonal wind roses for winds recorded at the private Carter Holt Harvey meteorological station during 2007. The annual wind rose indicates that mild to moderate winds tend to dominate from the east and typically range between 1.5m/s (5.4km/hr) and 10.5m/s (36km/hr). The seasonal wind roses indicate winds prevail from the following directions.

Spring	Summer	Autumn	Winter
East	East	East	West and Southeast

4.1.3.6 Temperature Inversions

Temperature inversions are often expressed as fogs and/or frosts and invariably occur of an evening with clear skies and when wind speeds are low or calm conditions prevail. On average, 78 days of the year experience temperatures below 2^{o}C, predominantly occurring between May and September with the greatest number occurring during July. Additionally, an analysis of the atmospheric stability using the Pasquill-Gifford-Turner assignment scheme (see Heggies 2010) indicates that the atmospheric stability Class F, which relates to highly stable conditions, typically associated with clear skies, light winds and the presence of a temperature inversion, occurs for approximately 15% of the time.

4.1.4 Surrounding Land Ownership, Land Uses and Residences

4.1.4.1 Surrounding Land Ownership

Figure 4.4 presents the existing land ownership within approximately 2km surrounding the Project Site. This information has been sourced from the Land Ownership Register maintained by the Department of Lands and feedback from local residents / land owners.

Being a rural area, most of the surrounding landholdings are substantial in size ranging up to 181ha although there have been an increasing number of lifestyle / rural-residential landholdings developed in the last 15 years in the area centred on Titania Road.

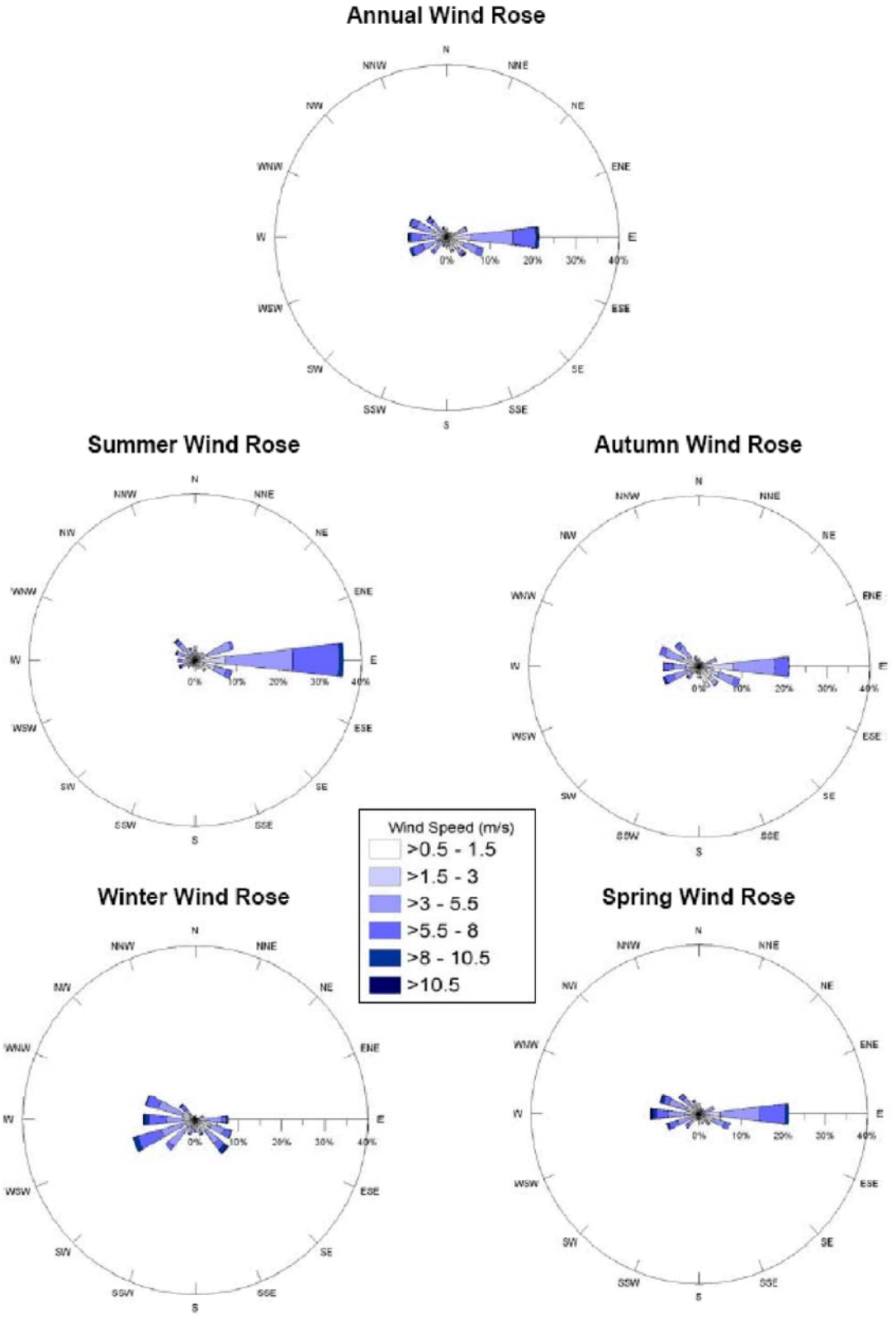
4.1.4.2 Land Uses

The Project Site is located within a rural / rural-residential area with the surrounding land use predominantly agricultural, grazing and some cropping and horticulture including a truffle farm which has been established to the south-southwest of the Project Site. As discussed in Section 4.1.4.1, there are also a number of lifestyle landholdings in the area which have both permanent residences and holiday residences. Dense native bushland is also located within and to the east and west of the Project Site.

4.1.4.3 Surrounding Residences

Figure 4.4 also presents the locations of the residences on the surrounding properties generally within 2km of the boundary of the proposed extraction area. **Table 4.2** lists approximate distances from representative residences surrounding the Project Site to the closest point of the existing approved and proposed extraction areas.

\\SERVER\RWC\709\70902\CAD\709Base_4.3 Wind Roses.DWG



Source: Heggies (2010)

Figure 4.3
ANNUAL AND SEASONAL WIND ROSES

Table 4.2
Surrounding Land Ownership and Residences

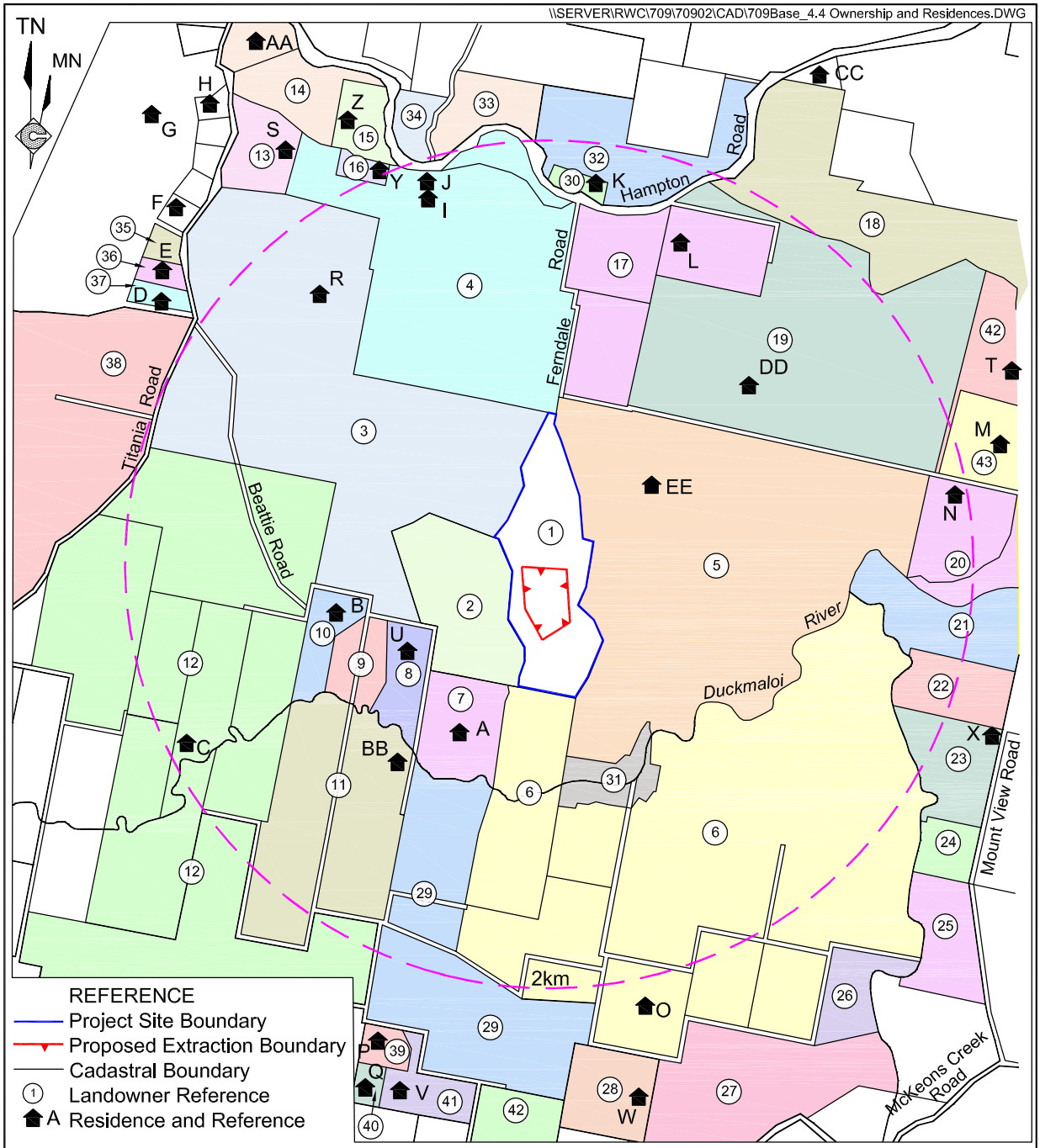
Ref No.	Landowner	Residence[1]	Approx. Distance (m) from Residence to		Direction from Project Site
			Approved Extraction Area	Proposed Extraction Area	
1	Mudgee Stone Company Pty Ltd	No Residence			
2	H.R. & S.P. Webb	No Residence			
3	C.J. & V.T. O'Neill	R	1710	1560	NW
4	W.A. & B.P. Armstrong	I / J	1920	1750	NNW
5	T.A. & J.M. Breed	EE[2]	735	555	NE
6	Lawndock Pty Limited	O	1780	1780	SSE
7	M.G. & J.A. Armstrong	A	560	560	SW
8	Z.H. Yang & W.Q. Liang	U	620	620	WSW
9	G. Nicholson	No Residence			
10	A.A. & M. Apoleski	B	890	890	W
11	Sutfol Pty Limited	BB	690	690	WSW
12	Bloomfield Pastoral Co. Pty Limited	C	1720	1690	SW
13	M. & K. Fenton	S	2430	2280	NW
14	R.P. Palfreyman & J.A. Ward	AA	2960	2780	NW
15	E.E. Mawhood	Z	2440	2270	NW
16	D.E. Whitley	Y	2180	2000	NW
17	Australian Feldspar Pty Limited	L	1790	1620	NNE
18	M.J. Mcleland	CC	2460	2310	NNE
19	D.J. &C.J. McFawn	DD	1300	1150	NE
20	P. & S. Koleda	N	1960	1850	E
21	B.R. Harman	No Residence			
22	P.S. & B.M. Young	No Residence			
23	C.C. Jackson	X	2010	2060	ESE
24	J.A. & P.J. Hudak	No Residence			
25	M.J. Brady	No Residence			
26	E.A. & H.L. Kalotay	No Residence			
27	D.J. & K.W. Sotter	No Residence			
28	G.G. Armstrong	W	2200	2200	SSE
29	I.W. Armstrong	No Residence			
30	R.E. & V.J. Lardner	K	1830	1680	N
31	Minister for Public Works	No Residence			
32	M.A. & K.E. Graham & Kadeema Pty Limited.	No Residence			

Notes: 1. Based on aerial photography and landholder / resident feedback. 2. Approved dwelling – not yet constructed

It is noted that an agreement is in place with the T.A & J.M Breed in relation to the approved dwelling within their landholding. For the purposes of this assessment, the proposed dwelling is considered to be Project-related.

A dwelling entitlement has also been approved (Development Consent DA 110/03) on Lot 12 DP 603429 owned by H.R. and S.P. Webb (see **Table 4.1** Reference No. 2) although a building envelope was not specified and any dwelling is subject to Council approval. It is noted that Condition 3 of DA 110/03 requires that "*the location and design of a dwelling on the land shall take into account the presence or potential presence, and the impacts or potential impacts, of any proposed or existing quarry operations on the adjoining lands*".

It is also noted that an application for a dwelling on Lot 12 DP 603429 was submitted by H.R. and S.P. Webb in August 2008 but was refused by Council on 17 February 2009. This was due to various reasons including that Council officers were not satisfied that the proposed location of the dwelling was suitable with regards to adjoining land uses, in particular, the existing and future operations of the quarry.



REF.	LANDOWNER	REF.	LANDOWNER	REF.	LANDOWNER
1	Mudgee Stone Company Pty Ltd	15	E.E. Mawhood	30	R.E. & V.J. Lardner
2	H.R. & S.P. Webb*	16	D.E. Whitley	31	Minister for Public Works
3	C.J. & V.T. O'neill	17	Australian Feldspar Pty Limited	32	M.A. & K.E. Graham &
4	W.A. & B.P. Armstrong	18	M.J. Mcleland		Kadeema Pty Limited
5	T.A. & J.M. Breed	19	D.J. & C.J. McFawn	33	J.K. & K.E. McQueen
6	Lawndock Pty Limited	20	P.& S. Koleda	34	State of NSW
7	M.G. & J.A. Armstrong	21	B.R. Harman	35	M.J. Colley & K.L. Simmons
8	Z.H. Yang & W.Q. Liang	22	P.S. & B.M. Young	36	M. & M.C. Puzicha
9	G. Nicholson	23	C.C. Jackson	37	M.D. & S.M. Mangan
10	A.A. & M. Apoleski	24	J.A. & P.J. Hudak	38	J.K. Hogan
11	Sutfol Pty Limited	25	M.J. Brady	39	R.M. & D.R. Armstrong
12	Bloomfield Pastoral Co. Pty Limited	26	E.A. & H.L. Kalotay	40	D.W. & B.E. Armstrong
13	M.& K. Fenton	27	D.J. & K.W. Sotter	41.	I.W. Armstrong
14	R.P. Palfreyman & J.A. Ward	28.	G.G. Armstrong	42	P.W. Fox
		29	W. Armstrong	43	S.J. & D.L. Reilly

* Land Parcel has a dwelling entitlement. No residence has yet been approved

SCALE 1:30 000

500 0 500 1000 1500 m

Land Ownership Source: NSW Department of Lands Online Title Search 2008

Figure 4.4
SURROUNDING LAND OWNERSHIP AND RESIDENCES

4.2 SOIL AND SURFACE WATER

4.2.1 Introduction

Based on the environmental risk analysis undertaken for the Project (see Section 3.3 and **Table 3.7**), the potential surface water and erosion and sedimentation impacts requiring assessment and their **unmitigated** risk rating are as follows.

- Continuing discharge or repeated major event resulting in long-term and wide spread degradation of water quality (High Risk).
- Reduced availability of water for agriculture (Moderate Risk).
- Stressing of downstream vegetation due to restricted flows (Moderate Risk).
- Isolated and minor event resulting in temporary degradation of off-site water quality (Moderate Risk).
- Minor erosion within the Project Site or major erosion external to the Project Site (Moderate Risk).

The following subsections provide a summary of the surface water assessment conducted by GSS Environmental (GSSE) (2010) and provides information on:

- the drainage network within the region, local area and within and surrounding the Project Site;
- the existing surface water quality;
- surface water management issues;
- surface water management control features and operational safeguards;
- an assessment of possible impacts on surface water and its availability; and
- proposed monitoring programs to be undertaken throughout the life of the Project.

A full copy of GSSE (2010) is presented as Part 1 of the *Specialist Consultant Studies Compendium*.

4.2.2 The Existing Environment

4.2.2.1 Regional Drainage

The Project Site is located within the Macquarie River Catchment in central New South Wales. The Macquarie and Bogan Rivers are the primary rivers within the catchment, of which the Bell, Talbragar, Cudgegong, Turon, Fish and Campbells Rivers are major tributaries.

The Macquarie River is primarily formed by the joining of the Campbells and Fish Rivers, which drain a high plateau area centred near Oberon. The Project Site, located approximately 6km east-southeast of Oberon, is therefore located close to the head of the Macquarie River catchment.

4.2.2.2 Local and Project Site and Drainage

The Project Site drains to the Duckmaloi River, which forms part of the Fish River catchment, a tributary of the Macquarie River. The Duckmaloi River is located approximately 500m south of the Project Site and flows in an easterly direction at this locality with the Duckmaloi Weir located approximately 300m downstream. The Duckmaloi Weir provides approximately 20ML of water storage.

Within the Project Site, two ephemeral drainage depressions are located one to the east and one to the west of the existing extraction area. The drainage depression adjacent the western edge of the extraction boundary is reasonably well defined but becomes less defined towards the north as the topography becomes flatter. These two drainage depressions converge south of the extraction area to become a 1st order stream which is a tributary of the Duckmaloi River and drains to an existing retention basin (Dam 3) located on the southern boundary of the Project Site before leaving the site (see **Figure 4.5**).

A number of other minor ephemeral drainage depressions are also located within the Project Site including a southerly flowing depression commencing near the western boundary of the Project Site and joining with the drainage depression located adjacent to the western edge of the existing extraction area. A poorly defined southerly flowing drainage depression also commences immediately south of the proposed stockpile area and flows towards the existing extraction area (see **Figure 4.5**). A number of clean water diversion works would be required and are further discussed in Section 4.2.4.

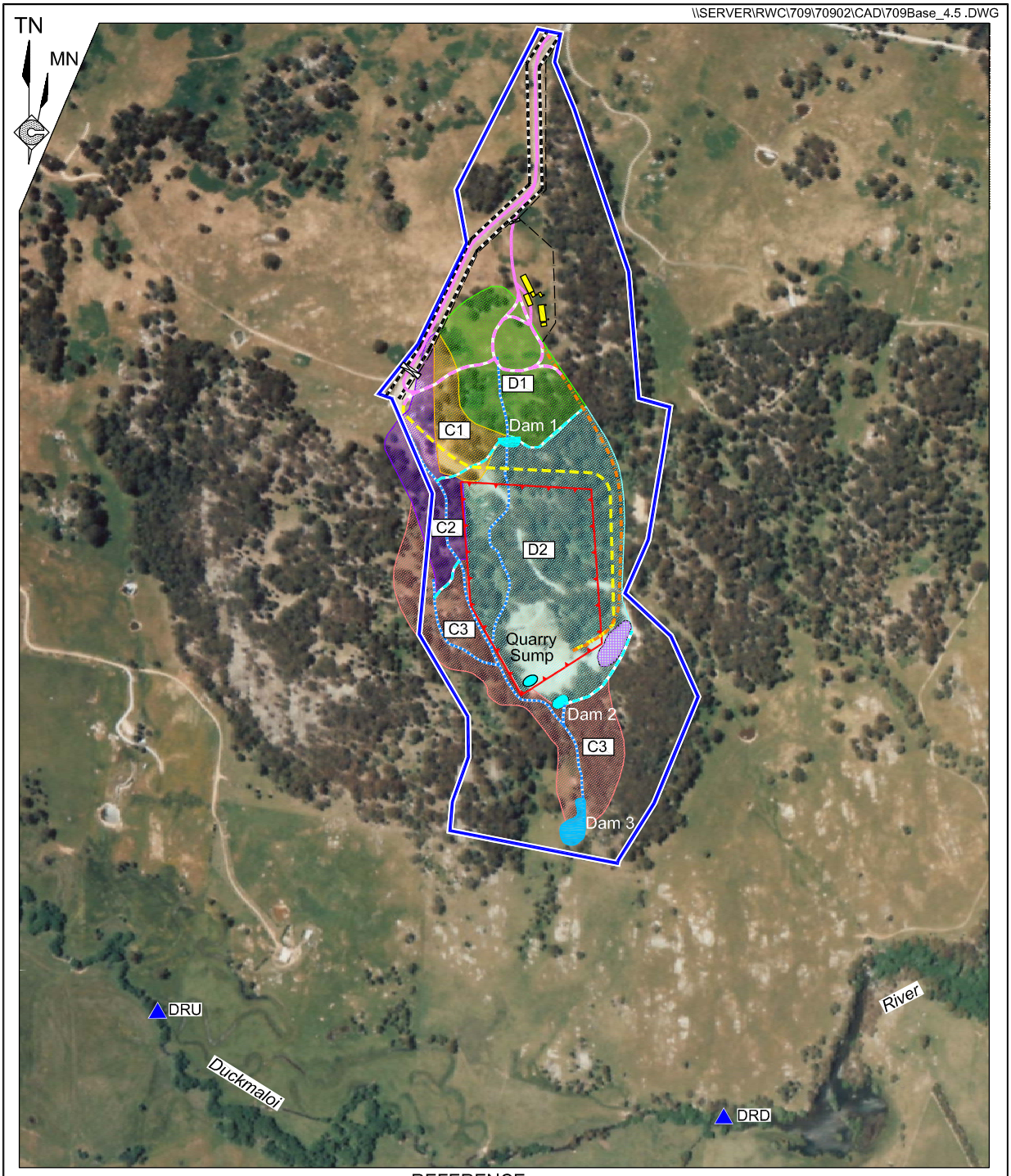
4.2.2.3 Surface Water Quality

A water sample was collected from Dam 3 on 28 November 2007 and sent to a laboratory for analysis. Results of the water quality analyses are presented in **Table 4.3** together with the default water quality objectives from the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)* (ANZECC), where applicable. The watercourses surrounding the Project Site are categorised as Upland Rivers according to ANZECC.

As shown in **Table 4.3**, the water results are generally consistent with the trigger values specified in the ANZECC guidelines. It is noted that zinc and iron levels are slightly above those recommended in ANZECC, however, pH, electrical conductivity and suspended solids are all well within the recommended ANZECC guidelines.

4.2.2.4 Project Site Soils

The Project Site coincides with an area mapped as the Duckmaloi soil landscape (Kovac and Lawrie 1990). The Dockmaloi soil landscape consists of siliceous sands with granite outcrops very common (Kovac and Lawrie 1990). The topsoil is described as brown or dark brown loamy sand whilst the subsoil is light grey to reddish brown sand to clayey sand. These soils are well drained, highly permeable, have a low fertility, being deficient in Nitrogen and Phosphorus, and have a pH of 5.0 to 6.0.



REFERENCE

- Project Site Boundary
- Proposed Extraction Boundary
- Proposed Internal Haul Road
- Proposed Site Access Road (Sealed)
- Proposed Internal Access Road (Unsealed)
- Proposed Internal Access Track
- Catchment Area
- DRU Water Monitoring Location
- Fence
- Gate
- Surge Stockpile Area
- Existing Sediment Retention Basin
- Existing Drainage Line
- Proposed Water Management Structure (Indicative Location)
- Proposed Diversion Bank (Indicative Location)

Source: Modified after GSSE (2010) - Figure 3

Figure 4.5
PROJECT SITE CATCHMENTS, DRAINAGE AND PROPOSED WATER MANAGEMENT STRUCTURES

Table 4.3
Surface Water Quality

Analyte (unit)	Existing Sediment Retention Basin	Trigger Value for freshwater	ANZECC Guidelines
pH	6.51	6.5-7.5	ANZECC Table 3.3.2 (Trigger values for South-East Australia, upland rivers)
Conductivity (µS/cm)	79	30-350	ANZECC Table 3.3.3 (Trigger values for upland rivers)
Suspended Solids (mg/L)	5	<40	ANZECC Guidelines for Physio-chemical stressors (freshwater)
Total Alkalinity as $CaCO_3$ (mg/L)	12	-	-
Sulphate as $SO4_{2-}$ (mg/L)	4	-	-
Chloride (mg/L)	7.7	-	-
Dissolved Major Cations			
Calcium (mg/L)	<1	-	-
Magnesium (mg/L)	<1	-	-
Sodium (mg/L)	12	-	-
Potassium(mg/L)	<1	-	-
Ionic Balance			
Total Anions (meq/L)	0.55	-	-
Total Cations (meq/L)	0.50	-	-
Total Metals			
Arsenic (µg/L)	2	24	ANZECC Table 3.4.1
Cadmium (µg/L)	<0.1	0.2	ANZECC Table 3.4.1
Copper (µg/L)	<1	1.4	ANZECC Table 3.4.1
Lead (µg/L)	<1	3.4	ANZECC Table 3.4.1
Manganese (µg/L)	46	1900	ANZECC Table 3.4.1
Zinc (µg/L)	9	8	ANZECC Table 3.4.1
Iron (µg/L)	350	300	2000 ANZECC Guidelines for Recreational Water Quality & Aesthetics
Source: GSSE (2010) – Table 6			

A range of soil samples were also collected by R.W. Corkery & Co. Pty Limited from within the Project Site from which two representative samples (SS1 and SS2) were sent to a laboratory for analysis whilst the remaining soil samples were subjected to field analyses. Sample SS1 was collected from the wall of the channel in the inlet to the southern retention basin whilst sample SS2 was collected from a sample pit dug adjacent to the existing site access road. **Figure 4.6** presents the locations of the soil sample sites.

Table 4.4 provides a summary of the field results whilst **Table 4.5** provides a summary of the laboratory results.

In general, the soils within the Project Site are Sandy or Silty Loams and Silty Clays of varying thickness becoming thin (less than 20cm) within some areas of the existing extraction area, proposed stockpile area and site access road. The topsoil layer ranges in thickness between 10cm and 30cm, is dark brown to light brown in colour with moderate organic content, particularly within the open woodland areas, is loose and gritty, occasionally with some gravel and field pH between 5.0 and 5.5. The underlying subsoil layer is light brown, reddish brown or light grey, is loose with increasing gravel with depth, field pH between 5.0 and 5.5, overlies weathered or fresh granite. These characteristics are consistent with the Duckmaloi soil landscape.

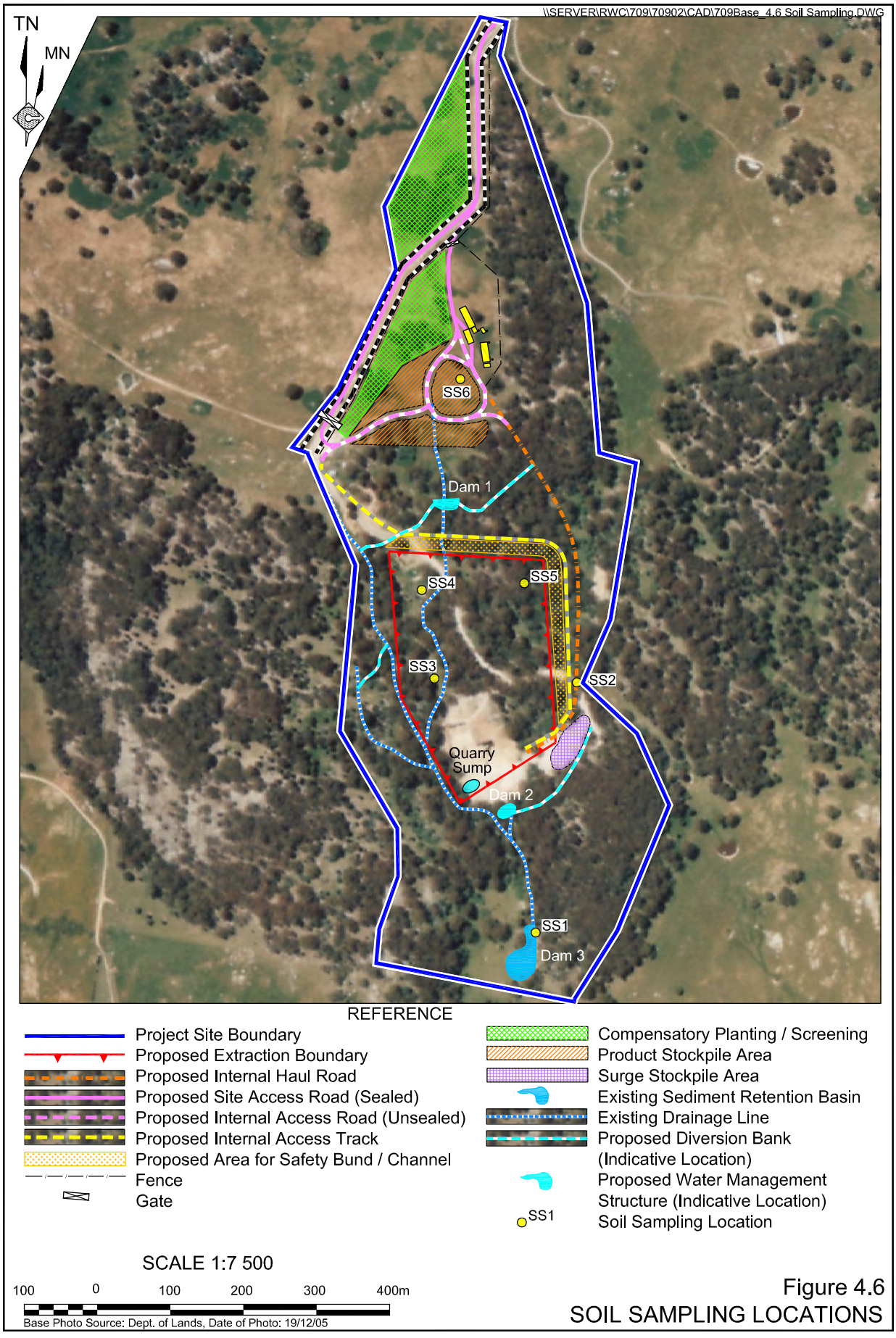


Figure 4.6
SOIL SAMPLING LOCATIONS

The laboratory results indicate that the soil samples collected at SS1 are Type C soils, that is, less than 33 percent of the soil materials are finer than 0.02mm (i.e. clay and silt), and less than 10 percent of the soil materials are dispersible. Type C soils are mostly coarse-grained, and will settle quickly in a sediment retention basin.

Soil samples collected at SS2, however, have been classified as Type F soils, that is, more than 33 percent of the particles are finer than 0.02mm, and less than 10 percent of the soil materials are dispersible. Type F soils are mostly fine-grained, and require a much longer residence time to settle in a sediment retention basin.

Table 4.4
Soil Sample Field Test Results

	EA Class & Notes	pH	Texture	Colour
SS1				
0cm – 15cm	(Class 7) Partial slaking (subclass 1)	5.0	Sandy Clay Loam – small gravel throughout, loose.	Very dark brown.
30cm – 40cm	(Class 7) Moderate slaking (subclass 2)	5.0	Loam Fine Sandy - gritty and some gravel, loose.	Light brown.
1.2m – 1.5m	(Class 7) Complete slaking (subclass 2)	5.0	Fine Sandy Clay Loam – some grit and gravel, loose.	Light brown / grey brown.
SS2				
0cm – 15cm	(Class 7) Partial slaking, slight swelling (subclass 0 to 1).	5.5	Silty Clay Loam – some grit, no gravel, loose.	Brown.
35cm – 40cm	(Class 7) Moderate to complete slaking (subclass 2).	5.5	Silty Clay – some grit and limited gravel, loose.	Light brown / reddish brown.
SS3				
0cm – 30cm	(Class 8) No slaking or swelling	5.5	Light Sandy Clay – very gritty, no gravel, loose.	Light brown / grey.
SS4				
0cm – 30cm	(Class 7) No slaking, slight swelling.	6.0	Fine Sandy Clay Loam – minor grit, no gravel, loose.	Dark brown.
SS5				
0cm – 30cm	(Class 7) Partial slaking (subclass 0 to 1).	5.0	Sandy Clay Loam –some grit, no gravel, loose.	Dark brown.
30cm – 40cm	(Class 7) Moderate to complete slaking (subclass 2).	5.5	Sandy Clay Loam – very gritty, some gravel, loose.	Light brown.
SS6				
0-10cm	(Class 7) No slaking, slight swelling.	4.5	Light Sandy Clay Loam – some grit, no gravel, loose. Underlain by consolidated material.	Light brown.

Table 4.5
Soil Sample Laboratory Results

Sample Id	EC (dS/m)	pH	Particle Size Analysis (%)						D%	EAT
			clay	silt	very fine sand	coarse fine sand	coarse sand	gravel		
SS1 0-15cm	0.01	5.4	8	15	11	7	42	17	0	3(1)
SS1 30-40cm	<0.01	5.4	15	14	12	9	32	18	25	5
SS1 120-150cm	<0.01	5.6	11	14	16	9	42	8	44	5
SS2 0-15cm	0.02	5.7	IS	IS	IS	IS	IS	0	IS	5
SS2 35-40cm	<0.01	5.5	24	21	20	9	24	2	20	5

Source: Modified after GSSE (2010) – Table 5
IS – insufficient sample EAT = Emerson Aggregate Test D% = Dispersion Percentage

4.2.3 Surface Water and Soil Management Issues and Constraints

The key surface water issues relating to the Project have been identified as follows.

1. Reduction of the inflow of water into the active work areas.
2. Reduction of the potential for the transport of sediment off site into watercourses, and the flow-on impact of sedimentation on receiving waters, i.e. the Duckmaloi River.
3. Management of ephemeral watercourses in accordance with the expectations of the NSW Office of Water.
4. Control of surface flows on rehabilitated areas to ensure minimal soils loss and adequate soil moisture for plant growth.

In addition to the key issues identified above, the recommended constraints required to be addressed by Landcom (2004) ("the Blue Book") are further discussed as follows.

Riparian Lands

Waterfront Lands (formerly known as Riparian Lands under the *Rivers and Foreshores Improvement Act 1948*) are those vegetated lands within 40m of waterbodies such as rivers, creeks, estuaries, lakes and wetlands.

The proposed extension to the extraction area would extend northwards towards the top of the catchments within the Project Site, and would not be within 40m of a river, creek, estuary, lake or wetland as defined by the Act (the 1st order stream being approximately 50m south of the extraction area). The proposed extraction area is adjacent to a number of small drainage depressions, however, these drainage depressions are minor, well grassed, located at the top of the local catchment, and are not marked as 'blue lines' on the 1:25 000 topographic map. Therefore, the Project would not result in any additional impacts upon riparian lands.

Erosion

The Project Site is considered to be located within a relatively low to moderate rainfall erosivity zone in accordance with the Blue Book. Based on analysis of soil samples collected within the Project Site and the moderate slopes, the soils within the Project site are sensitive to erosion without implementation of appropriate surface water and erosion control measures and can be classified as Type C and Type F soils. For assessment and design purposes, all soils have been conservatively considered as Type F soils which require greater management consideration.

Surface Water Runoff and Groundwater

Given the relatively steep relief within several of the Project Site sub-catchments, surface water runoff will be an important consideration in the design and location of best management practice water storages and catchment/diversion structures.

No significant groundwater source is likely to be intersected by the extraction activities. Any minor seepage that may occur in the active extraction area would be collected by a sump in the southwestern corner of the extraction area.

4.2.4 Water Management Controls and Operational Safeguards

4.2.4.1 Introduction

The information provided within the following subsections is drawn from the Soil and Water Management Plan (SWMP) prepared by GSSE (2010) (see Section 9 of the Surface Water Assessment – Part 1 of the SCSC) and outlines:

- the surface water management objectives for the Project;
- the water management catchments within the proposed areas of disturbance;
- the site water balance; and
- the proposed water management controls and safeguards.

4.2.4.2 Surface Water Management Objectives

The principal objective of surface water management at the Oberon White Granite Quarry is to ensure that the water quality leaving the site meets the appropriate water quality criteria. This objective would be achieved by:

- diverting 'clean water' runoff away from disturbed areas and off site;
- directing sediment-laden runoff to designated sediment retention ponds;
- maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments; and
- implementing an effective revegetation, maintenance and monitoring program.

4.2.4.3 Water Management Catchments

For management purposes, the water within the Project Site has been divided into two classes.

i) **"Clean" water** - surface runoff from undisturbed catchments or relatively undisturbed by extraction, processing or related activities.

ii) **"Dirty" water** - surface runoff from disturbed catchments such as the active extraction area, which could produce significant concentrations of suspended sediment.

GSSE (2010) has divided the Project Site into two main catchments, namely a clean water catchment, Catchment C and a dirty water catchment, Catchment D. Catchment C incorporates a total area of approximately 8.0ha and, for the purposes of designing appropriate water management structures, can be divided into three sub-catchments C1, C2 and C3 (see **Figure 4.5**). Catchment D incorporates a total area of approximately 13.2a and can be divided into two sub-catchments D1 and D2.

Catchment D1 has an area of 3.6ha and includes the proposed stockpiling area which is located at the very top of the catchment with very little runoff flowing through the stockpiling area requiring management. Catchment D2 consists of a total area of approximately 9.6ha and

includes a small area north of the extraction area which would contribute to runoff to the extraction area. For design purposes, it has been assumed that all water within Catchment D2 would contact disturbed areas.

Table 4.6 presents a summary of the defined catchments.

Table 4.6
Water Management Catchments

Catchment	Area (ha)	Project-Related Disturbance
Clean water catchments		
C1	1.2	Internal access track.
C2	2.2	Nil
C3	4.6	Nil
Total area	**8.0**	
Dirty water catchments		
D1	3.6	Product stockpile area and site access road.
D2	9.6	Active extraction area and surge stockpile
Total area	**13.2**	
Source: GSSE (2010) – Table 7		

4.2.4.4 Site Water Balance

GSSE (2010) has prepared a site water balance for the Project based upon the site water requirements and outputs and the water availability or inputs. The water balance is provided for average, wet and dry years (10^{th}, 50^{th} and 90^{th} percentile rainfall years) with rainfall data obtained from the Bureau of Meteorology monitoring station at Oberon (Station 063293), which is considered to be the most representative of the Project Site. As no significant groundwater is expected to be intersected during the extraction operation, groundwater seepage has not been included as an input to the water balance.

Outputs would include evaporative losses from the proposed sediment retention basins (estimated 0.8ML per year) and the use of 'dirty water' for dust suppression (approximately 15ML per year). The water balance for average, wet and dry years is presented in **Table 4.7**.

Table 4.7
Water Balance for the Oberon White Granite Quarry

Inputs and Outputs	Avg Yr (ML/Yr)	Wet Yr (ML/Yr)	Dry Yr (ML/Yr)
Input: Combined runoff from catchments C1, C2, C3, D1 & D2	66.9	83.7	43.3
Output: Evap. Losses and water for Dust Suppression	15.8	15.8	15.8
Excess	**51.1**	**67.9**	**27.5**
Source: GSSE (2010) – Table 12			

As can be seen in **Table 4.7**, there would be an excess of water in all scenarios. It is noted the majority of this 'excess water' would be clean water runoff diverted around the active extraction area.

4.2.4.5 Water Management Controls and Safeguards

Diversion of Clean Water

One of the primary objectives of water management on the Project Site would be the diversion of clean water away from the extraction area to adjacent drainage lines at non-erosive velocities. The following water management structures would be constructed to divert clean water runoff.

- Diversion Banks (Low Flow)

  Two clean water diversion banks would be constructed including one diversion bank north of the extraction area within Catchment C1 and a second diversion bank west of the extraction area within Catchment C3 (see **Figure 4.5**). The diversion bank to the north of the extraction area would divert water flowing from the top of the clean water catchment and any overflows from Dam 1 around the western side of the active extraction area into Catchment C2.

  The second diversion bank would divert water from the ephemeral drainage depression on the boundary of the extraction area to the drainage depression located further west. The diversion bank would be located towards the northern part of the drainage depression where the drainage line is much less defined and the topography is flatter.

  The diversion banks would be constructed generally in accordance with Blue Book Standard Drawing SD 5-5, with the following design specifications which have been based on 50 year ARI design calculations.

  – Gradient of approximately 1%.
  – Height of the bank at least 0.3m.
  – Channel depth of approximately 0.4m and base width of 1.0m.
  – A level spreader (or sill) constructed at the bank discharge point to reduce the risk of erosion.

  Diversion banks would be sown with a non-persistent cover crop within 10 days of construction to prevent erosion of the bank and drain until native grasses and groundcover are established.

- Road Crossings

  Part of the existing site access road would be retained as an internal access track. As shown on **Figure 4.5**, the diversion bank within Catchment C1 would cross the existing road. Despite the low flows expected in the channel, a pipe culvert would be installed to allow light vehicles to cross the diversion and minimise the potential for sediment mobilisation. Stabilisation works including use of geofabric and rock ballast would be undertaken within the diversion channel at the inflow and outflow points of the culvert.

- Road Drainage

  Given the relatively steep gradient (from a surface water control perspective) of the internal haul road, spoon drains would be constructed along its length as necessary. The primary function of the spoon drain would be to reduce the concentration and velocity of water flows within the road-side drainage and, therefore, minimise the potential for erosion and transport of sediment to discharge points.

Capture of Dirty Water

The principal measure for the capture of dirty water would be through the construction of sediment retention basins. A small sediment retention basin (Dam 1) with a capacity of 0.7ML would be constructed in Catchment D1 immediately to the north of the proposed extended extraction area boundary (see **Figure 4.5**). Dam 1 has been designed to exceed the requirements of a Type F sediment basin as defined by the Blue Book and would provide a second level of protection in the event that sediment controls around the product stockpiles fail during an extreme rainfall event. It is also noted that the capacity is sufficient to capture greater than a 1 in 100 year ARI rainfall event to prevent flooding of the active extraction area.

For runoff from Catchment D2 a 0.1ML sump would be constructed in the southwestern corner of the extraction area and a second sediment retention basin (Dam 2) immediately south of the southern batter of the extraction area (see **Figure 4.5**). Runoff within the extraction area would initially flow to the quarry sump effectively containing all dirty water runoff from the internal haul road and extraction area within the extraction area. As required, excess water from the quarry sump would either be pumped or siphoned to Dam 2. A diversion bank would also be constructed immediately downslope of the surge stockpile area and would direct runoff from the surge stockpile area directly to Dam 2.

Dam 2 has been designed to a Type F sediment basin in accordance with the Blue Book and would have a capacity of 2.18ML which would be sufficient to adequately manage runoff from the entire dirty water catchment (9.6ha) during a 5 day, 90th percentile rainfall event.

Any overflow from Dam 2 would be expected to meet relevant water quality criteria, however, the existing sediment retention basin adjacent the southern boundary of the Project Site (Dam 3) would be retained and stabilisation work undertaken (as described in Section 2.12.3.1) to ensure that only clean water reports to this dam. Dam 3 would also act as a 'back up' in the case of an extreme event that exceeds design capacities.

Additional Sediment Protection

Additional sediment controls would be installed, particularly during site establishment and construction, to reduce the velocity of flows, and therefore reduce the potential for erosion within channels and at the discharge points.

Sediment fences would be installed on the downstream periphery of all stockpile footprint areas, including the proposed stockpile area and surge stockpile, and temporary disturbance areas where the area draining to the fence is less than 0.6ha, the slope length is less than 60m and the slope is no greater than 1:2 (V:H). Straw bale filters and check dams may also be used as appropriate.

Exposed and disturbed areas would also be rehabilitated as soon as possible and practicable to minimise the erosion potential of the site.

4.2.5 Assessment of Impacts

The SWMP has been compiled to enable the capture of all dirty water generated by project-related activities and direct it to appropriately designed sediment retention basins and clean water to be diverted away from disturbed areas via diversion banks. The design of the sediment retention basins would ensure that sufficient time is provided for any suspended sediments to settle out. Furthermore, a level of redundancy has been provided through the over-design of the sediment retention basin (Dam 1), the design of Dam 2 without taking into consideration the additional holding capacity provided by the quarry sump and the retention and stabilisation of the existing sediment retention basin (Dam 3).

As the proposed sediment retention basins would be constructed for the purpose of preventing soil erosion and retaining contaminants (sediment) they would be exempt from harvestable rights calculations. Regardless, it is noted that the total on-site water storage capacity would be in the order of 3.98ML (Dam 1 = 0.7ML, Dam 2 = 2.18ML, Dam 3 ≈ 1.0ML and quarry sump approximately 0.1ML). This is slightly above the Maximum Harvestable Right Dam Capacity of 3.8ML. However, as the proposed sediment retention basins (Dams 1 and 2) and the quarry sump would be constructed for the purpose of *"containment and recirculation of drainage, required by regulation to prevent the contamination of a water source"* under the Farm Dams Policy, they would be exempt from these calculations. Dam 3 (~1.0ML) would therefore be well below the Maximum Harvestable Right Dam Capacity. All water required for dust suppression would also be sourced from dirty water sources (either Dam 1, 2 or the quarry sump) rather than through the use of clean water.

Based on existing water quality and soil laboratory results, it is also considered that the Project would not result in a salinity hazard either during operations or following rehabilitation.

It is therefore assessed that, the Project would be unlikely to significantly impact on surface water quality or availability to landholders downstream of the Project Site or environmental flows within the local watercourses.

4.2.6 Monitoring Program

Monitoring Locations

Table 4.8 identifies the monitoring point locations, the type of monitoring point along with a brief description of the location and frequency. The frequency of sampling would be reviewed annually and adjusted in consultation with the DECCW.

Water Quality

Table 4.9 presents the parameters that would be measured at each monitoring location. The recorded values for the parameters measured would be assessed against the existing water quality monitoring results and the ANZECC trigger values presented in **Table 4.3**, and plotted to identify any trends over time. The range of analytes measured would be reviewed following the first 12 months of monitoring and a diagnostic set of analytes adopted for ongoing monitoring. Water quality monitoring results would be presented within each Annual Environmental Management Report. In the event that monitoring identifies an ongoing upward trend of one of more of the analytes, the water management measures would be reviewed in consultation with DECCW NSW Office of Water.

Table 4.8
Proposed Monitoring Locations

Location*	Type of Monitoring Point	Description of Location	Frequency
Dam 1	Water Quality	Proposed dam located above extraction area	Quarterly
Dam 2	Water Quality	Proposed dam located below extraction area	Quarterly
Dam 3	Water Quality	Existing dam located at southern boundary of the Project Site	Quarterly and within 24 hours of any discharge (up to 4 times per year).
Duckmaloi River – Upstream (DRU)	Water Quality	Upstream of the Project Site	Annually (if creek flowing) and within 24 hours of any discharge (up to 4 times per year).
Duckmaloi River – Downstream (DRD)	Water Quality	Downstream of the Project Site	Annually (if creek flowing) and within 24 hours of any discharge (up to 4 times per year).
Project Site water management (erosion and sediment control) structures	Erosion and Sediment Control	All noted erosion and sediment control structures.	Monthly and after significant rainfall events
Source: GSSE (2010) – Table 13			* See **Figure 4.5**

Table 4.9
Monitoring Parameters

Location	Parameters	Sampling Method
Dams 1, 2 and 3	Total Suspended Solids	Representative sample
	pH	
	Electrical Conductivity	
Duckmaloi River – upstream and downstream	pH	Representative sample
	Total Suspended Solids	
	Total Dissolved Solids	
	Specific Conductance	
	CO_3 (as $CaCO_3$)	
	HCO_3 (as $CaCO_3$)	
	Calcium	
	Chloride	
	Iron (filterable)	
	Potassium	
	Magnesium	
	Manganese	
	Sodium	
	Sulphur (as SO_4)	
	Total Hardness (as $CaCO_3$)	
Source: Modified after GSSE (2010) – Table 14		

Erosion and Sediment Control

Water management structures (as outlined in Section 4.2.4.5) including the diversion banks, sediment retention dams, spoon drains and sediment fencing would be inspected on a monthly basis, or following a rainfall event of >25mm/24hr. During inspections, assigned personnel would note the general condition and effectiveness of the on-site water management structures and remaining capacity. In the event that any upgrade or stabilisation works are required, these would be completed as soon as possible.

4.3 GROUNDWATER

4.3.1 Introduction

Based on the environmental risk analysis undertaken for the Project (see Section 3.3 and **Table 3.7**), the potential groundwater impacts requiring assessment and their **unmitigated** risk rating are as follows.

- Contamination requiring major recovery works (Moderate Risk).
- Drawdown resulting in reduction of bore or local springs yields of >15% (Moderate Risk).
- Drawdown resulting in reduction of bore or local springs yields of <15% (Low Risk).
- Contamination requiring minor recovery works (Low Risk).

The following subsections provide information on:

- the existing hydrogeological environment regionally, and locally and the presence and use of groundwater resources on properties surrounding the Project Site (Section 4.3.2);
- management and mitigation measures to be implemented to protect known and potential groundwater resources (Section 4.3.3);
- a qualitative assessment of possible impacts on the existing groundwater resources including groundwater level, yields, quality, availability and the potential cumulative impact associated with surrounding developments (Section 4.3.4); and
- monitoring to be undertaken throughout the life of the Project (Section 4.3.5).

4.3.2 The Existing Environment

4.3.2.1 Regional and Local Hydrogeology

The nature and occurrence of the alaskite resource with its continuity as a massive rock body at depth results in limited groundwater being present. Groundwater occurs either within shallow zones where localised weathering has allowed infiltrating rainfall to accumulate or localised fracture zones near the surface. Whilst groundwater occurrences are present, a continuous groundwater table is unlikely due to the localised nature of the weathering and/or fracture zones.

The groundwater resources present beneath the alaskite resource are invariably localised and whilst some may intersect the surface at local springs, the quantity of water available is limited. In many cases, the springs could dry up.

Beyond the boundary of the alaskite resource, the surrounding rocks would contain a range of groundwater resources reflecting the presence of either natural permeability in the rock types or more likely the fractures created by faulting and jointing. There would be negligible connectivity between the groundwater resources in the rocks surrounding the alaskite resource and the localised groundwater occurrences within the alaskite itself.

4.3.2.2 Groundwater Use, Availability and Quality

Limited groundwater was intersected in nine out of 29 exploration bores drilled in May 2003, however, insufficient volumes of water were encountered to enable samples to be collected. These holes were drilled to a maximum depth of 23.4m with moist material encountered at varying depths between 9.1m and 16.9m below ground level (see **Figure 2.2**). Based on the Proponent's experience with the existing operation, the water intersected was representative of shallow and unconnected perched aquifers rather than a significant groundwater resource.

Limited data is also available from eleven registered bores within a 3km radius from the closest point of the proposed extraction boundary (see **Table 4.10** and **Figure 4.7**). The closest bore, GW801330 is located approximately 570m to the southwest of the closest point of the proposed extraction area. The bore is located on the fringe of the alaskite resource at an elevation of approximately 1 065m AHD. The elevation of the recorded standing water level is approximately 1 058m AHD. The bore log confirms that the water-bearing zone is located within granite. The next closest registered bores are located to the south (GW802990) and to the northwest (GW801754) approximately 1.4km and 2.3km respectively from the proposed extraction area. An inspection of the bore logs and geological map confirms that these bores are located in geological units separate from the Oberon alaskite, namely basalt and shale.

In addition to the registered groundwater bores, two surrounding landholders, A.A. & M. Apoleski and C.J. & V.T. O'Neill, advise that their properties contain spring fed dams which are used for stock watering and general purposes. It is also understood that water is obtained from an old exploration hole located on C.J & V.T O'Neill's property. Springs have also been reported to occur within a drainage line of two additional landholders, T.A. & J.M. Breed and H.R. and S.P. Webb (see **Figure 4.7**).

The Proponent has inspected the springs / seeps and exploration bore located on C.J. & V.T. O'Neill's, H.R. and S.P. Webb's and T.A. & J.M. Breed's properties. The springs on these properties are located within drainage lines and it is understood that the springs flow following rainfall and then continue to seep for varying periods. Similarly, the exploration bore provides intermittent water supply providing most reliable water supply following rainfall. No water quality data is available.

Table 4.10
Registered Groundwater Bores

Bore*	Usage	Collar Elevation (m AHD)	Distance to closest point of proposed extraction area (m)	Final Bore Depth (m, below surface)	Water-bearing Zones (mbgl)
801326	Domestic Stock	1150	2480	40	18 – 18.3 27.1 – 27.4 35.5 – 36
070870	NA	1170	2520	NA	NA
801754	Domestic Stock	1140	2360	50	45.2 – 45.5
801330	Domestic Stock	1070	570	36	30 – 30.3
800135	Domestic Stock	1155	1930	58	36.3 – 36.4 51 – 51.3
056745	Domestic Stock	1140	1910	38.1	18.2 – 18.5 24.3 – 24.6 32.9 – 33.2
801331	Domestic Stock	1130	2360	42	34 – 36
801718	Domestic Stock	1090	3440	45	18.3 – 18.6
033430	Domestic	1100	3320	27.4	18.3 – 25.6
801530	Domestic Stock	1150	2870	88	NA
050377	Domestic Stock	1150	3170	31.4	15.2 – 15.8 25.3 – 25.6
801443	Domestic Stock	1150	3090	75	72 – 72.1
801662	Domestic Stock	1140	3120	54	51.1 – 51.5
802327	Domestic Stock	1130	3170	42	25 – 26
801585	Domestic Stock	1150	2940	43	40.1 – 40.4
801173	Domestic Stock	1150	2840	42	33 – 33.5 39 – 39.5
070273	NA	1160	2970	46	31 – 33.2 41 – 43
802007	Domestic Stock	1110	3620	60	47.1 – 47.4
803863	Domestic Stock	1170	2695	NA	NA
802989	Domestic	1130	2020	82.5	19 – 19.5 41 – 41.5 62 – 62.5 73 – 73.5
802990	Stock	1120	1450	39	7 – 8 10 – 10.5 16 – 16.5 26 – 26.5 32 – 32.5
802718	Domestic	1140	3950	104	12 – 12.5 31 – 31.5 83 – 84 90.5 – 91

Source: DECCW Groundwater Database. NA – Not Available mbgl = metres below ground level *See Figure 4.7

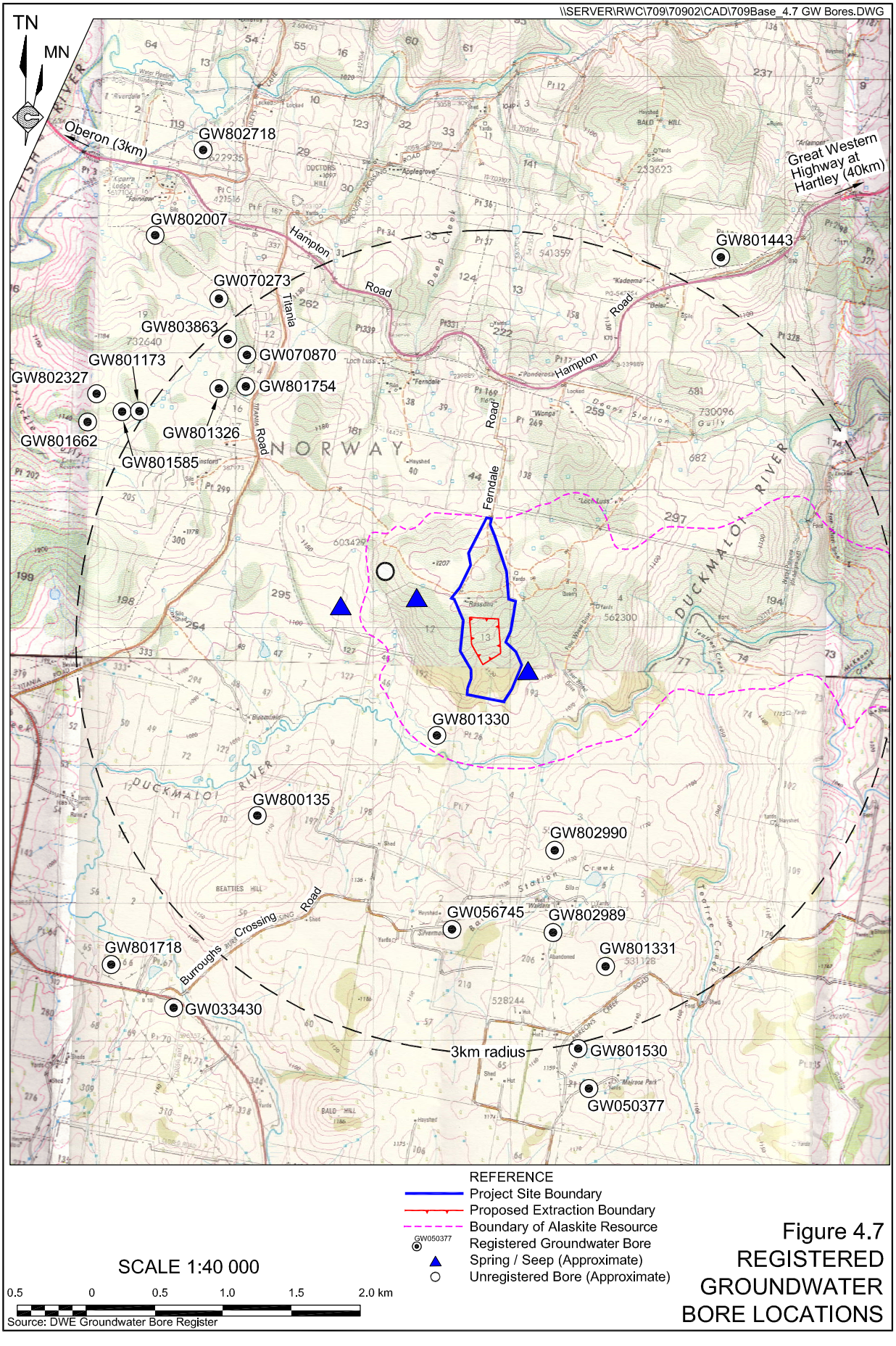


Figure 4.7
REGISTERED GROUNDWATER BORE LOCATIONS

4.3.3 Management Controls and Mitigation Measures

Best practice surface water controls and mitigation measures outlined in Section 4.2.4 which limit potential contamination of surface water from sediments and hazardous materials would equally be applicable to protect the groundwater resources.

Any minor seepage into the extraction area would be collected within the quarry sump and sediment retention basin (Dam 2) and would be managed with captured dirty surface water runoff. Based on the quality of water measured within the existing sediment retention basin (Dam 3) (see **Table 4.3**), it is not considered likely that ongoing extraction would result in increased acidity or salinity of captured runoff. In any event, ongoing water quality monitoring within the existing and proposed sediment retention basins would continue to be undertaken (see Section 4.2.6). Additionally, monitoring of surrounding groundwater bores would also be undertaken with the agreement of landholders (see Section 4.3.5).

Due to the limited presence of groundwater within the extraction area, no further management controls are considered necessary. However, in the event that any permanent or significant inflows of groundwater were to occur, the water balance for the Project would be revised and the required management measures reviewed in consultation with the NSW Office of Water.

4.3.4 Assessment of Impacts

It is considered unlikely that, in the event that groundwater was intersected, there would be any adverse effects upon surrounding groundwater users. Specifically, the reported water level within the closest registered bore (GW801330) located within the alaskite is approximately 1058m AHD whilst the proposed extraction depths would not decrease below 1 130m AHD. In the event that any significant volumes of groundwater were encountered, the hydraulic head would still be maintained at least 72m above the bore (ie. no significant depressurisation is expected). Similarly, any subsurface groundwater flows to the Duckmaloi River, which is located at an elevation of approximately 1 060m AHD in the vicinity of the Project Site, are highly unlikely to be affected.

The elevation of the next closest registered bores GW802990 and GW801754 are 1 120mAHD and 1 150m AHD. As these bores are located approximately 1.9km and 2.3km respectively from the proposed extraction area and the fact that they are located in separate geological units, it is also considered highly unlikely that they would be affected by the Project.

The exploration hole within C.J. & V.T. O'Neill's property is located at an elevation of approximately 1 170m AHD at a distance of approximately 700m from the closest point of the extraction area. The standing water level of this bore is not available. Based on the Proponents knowledge of the water supply being most reliable following rainfall events and the local geology, it is considered unlikely that the water supply would be related to a significant aquifer which also intersects the extraction area. Therefore it is also highly unlikely that the groundwater levels or availability within this bore would be affected by the Project.

In relation to the surrounding springs, the source of water for the springs is considered to be most likely a reflection of surface topography and localised fracturing relating to the water courses in which the springs are located. As the springs are all located within separate catchments to the extraction area, it is considered unlikely that there would be any adverse impacts as a result of the Project.

Following completion of extraction, the quarry sump would be retained and collect any surface water flows and seepage occurring following rainfall. As discussed in Section 4.3.3, it is expected that the water quality would not be adversely affected and would therefore remain suitable for the planned final land use of nature conservation.

4.3.5 Monitoring

In order to demonstrate that the Project does not result in adverse impacts upon surrounding groundwater users, in consultation with the respective landowners, the Proponent proposes to monitor the standing water level within the closest registered groundwater bore, GW801330 located approximately 570m to the southwest of the extraction area, and the exploration hole within C.J. & V.T. O'Neill's property on a monthly basis. The standing water levels would be reviewed in light of previous meteorological conditions, pumping records provided by the landholder and records of any groundwater inflows to the extraction area. The frequency of monitoring and/or need for ongoing monitoring would be regularly reviewed throughout the life of the Project to ensure only meaningful data is being collected.

The results of the monitoring would be presented within each Annual Environmental Management Report. In the unlikely event that groundwater levels are considered to have been affected as a result of the Project, the Proponent would undertake further consultation with DECCW NSW Office of Water and the affected landholder to mitigate or compensate for those impacts.

4.4 FLORA

4.4.1 Introduction

Based on the environmental risk analysis undertaken for the Project (see Section 3.3 and **Table 3.7**), the potential flora impacts requiring assessment and their **unmitigated** risk rating are as follows.

- Disturbance leading to local extinction(s) (Extreme Risk).
- Disturbance leading to local population reduction (High Risk).
- Disturbance to Threatened flora and endangered communities (Moderate Risk).
- Disturbance to native vegetation / habitat within nominated areas (High Risk).
- Disturbance to native vegetation / habitat outside nominated areas (Moderate Risk).

The following subsections describe the existing vegetation communities and flora species within and surrounding the Project Site and their conservation significance. The potential impacts that the Project would have on these vegetation communities and any Threatened flora species are described together with the design and operational safeguards and management procedures to be adopted.

The information presented in this section is drawn from the flora assessment undertaken by Gingra Ecological Services (Gingra, 2010) whose full report is included in the *Specialist Consultant Studies Compendium* (Part 2). This subsection presents a summary of the contents of the flora assessment report.

4.4.2 Previous Surveys

The Project Site was initially surveyed by Central West Environmental Services (CWES) in Spring between 18 and 21 October 2003. Since that survey, the then Department of Environment and Conservation – Parks and Wildlife Division, now Department of Environment, Climate Change and Water (DECCW), released the draft *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004).

The results of the initial survey together with searches of relevant databases were used as a basis for the methodology for a second survey by CWES in accordance with the 2004 guidelines. The second field survey was carried out in early Autumn between 6 and 8 March 2007.

The 2003 vegetation survey was undertaken using the stratified random sampling method with three $10m^2$ quadrats placed in three identified vegetation zones within the proposed area of disturbance. Random meander searches targeting plant species of conservation significance were also undertaken over the remainder of the Project Site and identified species not contained within the quadrats were also recorded.

The 2007 survey was aimed at characterising the vegetation present in the area likely to be affected by the site access road, the new office, amenities and stockpiling areas. A total of one additional quadrat was placed with random meander searches again undertaken over the entire Project Site to check for seasonal differences.

CWES recorded 65 plant species occurring on the Project Site, comprising 45 native plant species and 20 exotic species. None of the species detected by CWES are listed as threatened species under the *Threatened Species Conservation Act 1995* (TSC Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

4.4.3 Study Methodology

A site inspection of the Project Site was completed on 11 November 2009 to complement and verify previous surveys undertaken (see Section 4.4.2). During the inspection, notes were made on the distribution of canopy species and their relationship to environmental characteristics including aspect, elevation, topographic position and soils; the floristics within different vegetation types; the presence of weed species and the presence of any threatened or significant flora species. The site visit involved traversing all areas of native vegetation within and adjacent to the proposed disturbance footprint, as well as areas of native vegetation on the Project Site which may be retained.

An updated search of the online Atlas of NSW Wildlife and EPBC Protected Matters Database was also undertaken on 24th March 2010.

4.4.4 Results

4.4.4.1 Vegetation Mapping Units

Four vegetation map units were identified by Gingra (2010) to be present within and surrounding the Project Site. The vegetation map units are described as follows and shown on **Figure 4.8**.

1. Narrow-leaved Peppermint-Mountain Gum-Ribbon Gum Grassy Woodland

Sheltered south-facing slopes on granite-derived shallow, loamy sandy soils support a grassy woodland dominated by Narrow-leaved Peppermint (*Eucalyptus radiata*), Mountain Gum (*E. dalrympleana*) and Ribbon Gum (*E. viminalis*). Associated tree species include Blackwood (*Acacia melanoxylon*).

There is a shrub layer of very low cover and a ground layer of medium cover.

Common shrub species include *Hibbertia obtusifolia*, *Lomatia myricoides*,

Common ground layer species include Snow Grass (*Poa sieberiana* ssp. *sieberiana*), Prickly Starwort (*Stellaria pungens*), Creamy Candles (*Stackhousia monogyna*), Spiny Mat-rush (*Lomandra longifolia*), *Cynoglossum suaveolens*, *Caladenia alba*, *Veronica calycina*, *Viola betonicifolia Euchiton involucratum* and *Senecio prenanthoides*.

Grazing and other impacts of human disturbance means that there is a range of exotic species within this vegetation map unit. These include Sheep Sorrel (*Acetosella vulgaris*), Yorkshire Fog (*Holcus lanatus*), Catsear (*Hypochaeris radicata*), Silvery Hairgrass (*Aira cupaniana*), Sweet Vernal Grass (*Anthoxanthum odoratum*) and Blackberry (*Rubus ulmifolius*).

2. Ribbon Gum Woodland

Steep gullies either side of the currently approved extraction area support woodland dominated by Ribbon Gum (*E. viminalis*). Associated tree species include Mountain Gum (*E. dalrympleana*) and Narrow-leaved Peppermint (*E. radiata*).

This vegetation map unit has a greater degree of shrub cover than Map Unit 1 and includes more mesic ground layer species. This reflects higher water availability and greater accumulation of colluvial material.

Shrub species present include Mountain Baeckea (*Baeckea utilis*) and *Lomatia myricoides*.

Ground layer plants include Weeping Meadow Grass (*Microlaena stipoides*), *Luzula flaccida*, Prickly Starwort (*Stellaria pungens*), Stinging Nettle (*Urtica incisa*) and *Helichrysum scorpioides*.

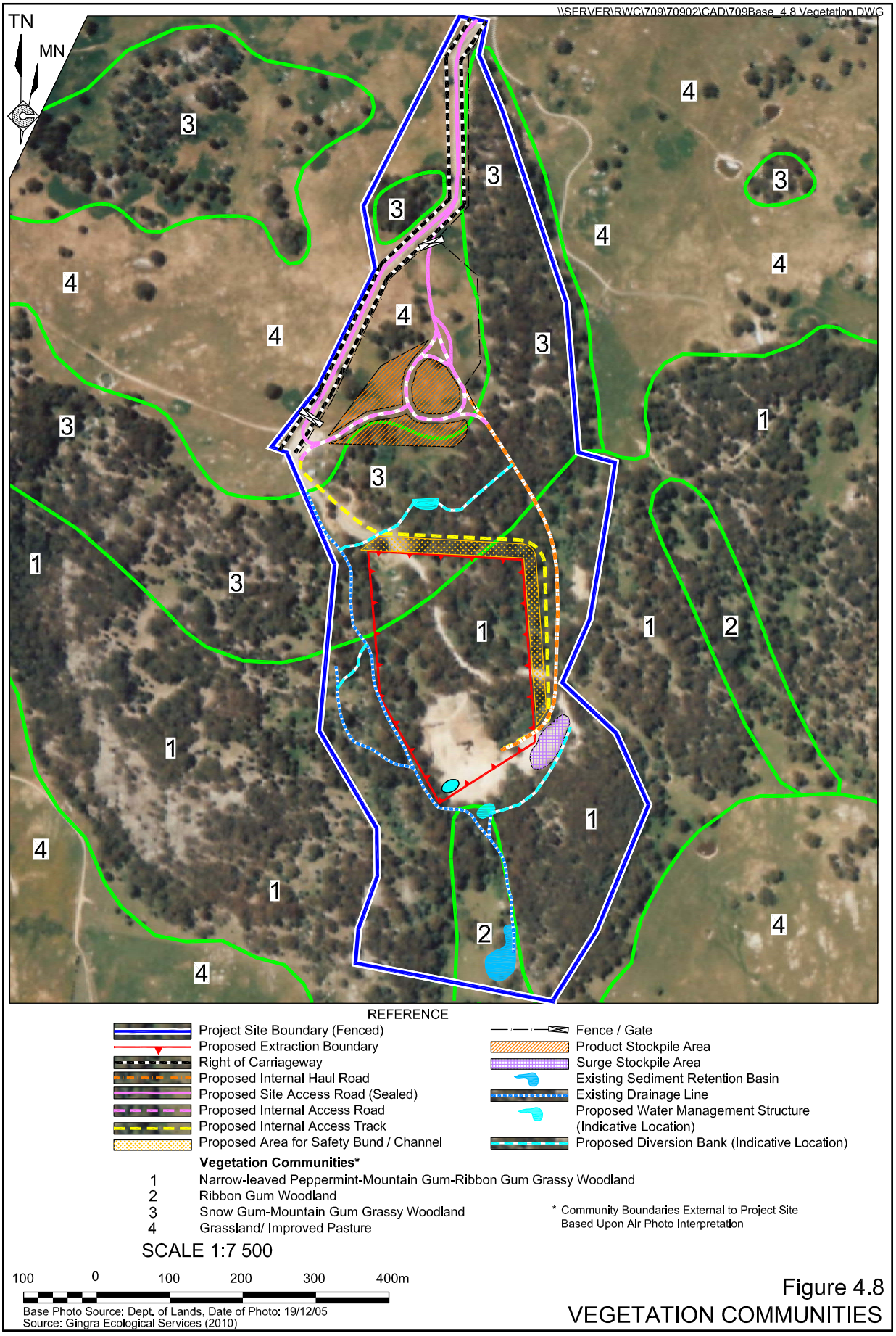


Figure 4.8
VEGETATION COMMUNITIES

This vegetation map unit has been affected by past land use with a relatively higher level of weed invasion than that for Map Unit 1. Exotic species present include Blackberry (*Rubus ulmifolius*), Spear Thistle (*Cirsium vulgare*), White Clover (*Trifolium repens*), Fleabane (*Conyza* sp.) and Sheep Sorrel (*Acetosella vulgaris*).

3. Snow Gum-Mountain Gum Grassy Woodland

Crests and exposed slightly to moderately inclined slopes above 1 140m elevation on loamy sands associated with the Duckmaloi soil landscape support a grassy woodland dominated by Snow Gum (*E. pauciflora*) and Mountain Gum (*E. dalrympleana*). Associated tree species include Blackwood (*Acacia melanoxylon*) and Narrow-leaved Peppermint (*E. radiata*).

The ground layer includes a mix of native and exotic species. Common native ground layer plants include Blue-leaved Snow Grass (*Poa sieberiana* ssp. *cyanophylla*), Bracken Fern (*Pteridium esculentum*), *Viola betonicifolia*, Prickly Starwort (*Stellaria pungens*), *Galium ciliare*, *Plantago debilis*, Bear's Ear (*Cymbonotus lawsonianus*) and Native Bugle (*Ajuga australis*).

Common exotic species include Suckling Clover (*Trifolium dubium*), Sweet Vernal Grass (*Anthoxanthum odoratum*), Sheep Sorrel (*Acetosella vulgaris*), Spear Thistle (*Cirsium vulgare*) and Yorkshire Fog (*Holcus lanatus*). Where narrow, fragmented patches of this vegetation map unit remain, pasture species such as Cocksfoot (*Dactylis glomerata*), Perennial Ryegrass (*Lolium perenne*), White Clover (*Trifolium repens*) and Subterranean Clover (*Trifolium subterraneum*) are present.

4. Grassland/Improved Pasture

Cleared areas on upper slopes and crests support improved pasture dominated by exotic pasture species and weeds. In terms of fauna habitat, these areas are described as grassland. CWES found in their 2007 survey that this vegetation type mainly consists of grasses and clovers, flatweed and areas of bracken fern and rocky outcrops. It was found to support introduced species like the small sedge *Juncus articulatus* and Capeweed (*Arctotheca calendula*) along with pasture improvement species Paspalum (*Paspalum dilatatum*) and Subterranean Clover (*Trifolium subterraneum*). Although formal survey was not completed over this area during the supplementary survey, based on informal survey, Gingra Ecological Services concurs with these findings.

None of these vegetation mapping units are considered to constitute Endangered Ecological Communities nor are any considered likely to occur within the Project Site. Additionally, none of the vegetation within the Project Site is considered to constitute a Groundwater Dependent Ecosystem in accordance with the meaning under *The NSW State Groundwater Dependence Ecosystem Policy* (DLWC 2002).

4.4.4.2 Threatened Flora Species

In addition to the species recorded by CWES, Gingra (2010) recorded a total of 10 additional native species and seven additional exotic species. None of the species recorded by either CWES or Gingra (2010) are listed as threatened species under the TSC or EPBC Act.

Based on the online search of the Atlas of NSW Wildlife and EPBC Protected Matters Database, four threatened flora species listed under the TSC Act and/or EPBC Act have previously been recorded within 10km of the Project Site (see **Table 4.11**).

Table 4.11
Threatened Flora Species Recorded within 10km of the Project Site

Family	Scientific Name	Common Name	Risk Status TSC	Risk Status EPBC
Asteraceae	*Calotis glandulosa*	-	V[1]	V[2]
Myrtaceae	*Eucalyptus aggregata*	Black Box	V[1]	-
Myrtaceae	*Eucalyptus pulverulenta*	Silver-leaved Mountain Gum	V[1]	V[2]
Santalaceae	*Thesium australe*	Austral Toadflax	V[1]	V[1]
[1] Vulnerable [2] Recorded through NSW Wildlife Atlas but not listed in EPBC search 24/03/10.				
Source: Gingra (2010) – Table 1				

Based on species profile information and an assessment of the likelihood of each species occurring on the Project Site, these species are considered unlikely to occur within the Project Site. No further formal assessment for these species was considered warranted.

4.4.5 Safeguards and Mitigation Measures

4.4.5.1 General Safeguards and Mitigation Measures

As discussed within Section 2.12.3, the Project Site would be progressively rehabilitated to maximise cover of native vegetation and minimise opportunities for erosion and weed invasion. Emphasis would be placed on the use of species indigenous to the locality including the Ribbon Gum, a Koala feed tree.

The following measures would also be implemented to minimise and mitigate impacts on native vegetation within the Project Site.

- Vegetation to be retained would be clearly defined and marked prior to the commencement of site establishment to ensure that native vegetation clearing is confined only to those areas required for Project operations.
- Noxious weeds would be controlled on the Project Site.
- Before being brought to site, machinery which has been working within foreign soil material would be cleaned down to minimise the risk of introducing weeds and plant pathogens.
- Domestic grazing animals would be excluded from the Project Site except for managed fire and fuel load control.
- Annual reporting of the progress and performance of rehabilitation and effectiveness of management measures.

4.4.5.2 Biodiversity Offsets and Compensatory Planting

As the removal of native vegetation is required to enable the Project to proceed, the use of a biodiversity offset and compensatory planting would be utilised to minimise the total impact of the Project. Given the type of native vegetation to be removed, an offset ratio of at least 2:1 for the native vegetation identified on site is considered to be appropriate.

The total area of disturbance is approximately 11.0ha, however, the proposed extension would only result in the removal of approximately an additional 7.1ha of woodland communities (Vegetation Map Units 1 [4.9ha], 2 [0.2ha] and 3 [2.0ha]) and 2.5ha of grassland/improved pasture. Therefore, as the grassland/pasture is dominated by exotic species and is considered to have minimal conservation significance it is considered that the appropriate offset area required for the Project would be 14.2ha of like for like vegetation.

The area surrounding the extraction area and to the south of the extraction area within the Project Site contains the highest quality vegetation and represents a suitable offset. The remnant woodland adjacent the northeastern boundary would also provide suitable offset area. These two areas (see **Figure 2.9**) total approximately 17.2ha providing an offset ratio of approximately 2.5:1. The offset areas would be protected through a covenant or similar arrangement and improved through careful planting of selected species, including Ribbon Gum, and ongoing control of weed species, particularly within the drainage lines.

Additionally, two compensatory planting areas, totalling approximately 2.5ha, would be established adjacent to the site access road in areas which would have originally supported Vegetation Map Unit 3, namely Snow Gum-Mountain Gum Grassy Woodland. These areas currently contain patches of established trees, however, planting of a range of canopy and mid storey species together with the control of weeds would be undertaken. These areas would also be effectively excluded from disturbing activities associated with operation of the Project.

In light of the fact the vegetation proposed to be cleared is not an Endangered Ecological Community and no threatened flora species were identified or likely to occur, it is considered the proposed offset, covering approximately 17.2ha, and compensatory planting of 2.5ha (totalling 19.7ha) would be adequate to compensate for the removal of the 7.1ha of native vegetation that would be disturbed as a result of the Project. Final arrangements and necessary covenants etc. relating to offsets would be negotiated with DECCW prior to commencement of vegetation clearing.

4.4.6 Assessment of Impacts

No Threatened flora species were recorded within the Project Site and an assessment of the habitat requirements for four threatened flora species previously recorded in the locality indicates that the habitat present within the Project Site is either unsuitable for the species, or no longer suitable due to the extent of past disturbance. Therefore it is considered that the Project would not significantly affect any of these species.

In relation to Endangered Ecological Communities, no TSC Act or EPBC Act listed endangered ecological communities occur on the Project Site.

Therefore, no further consideration of Threatened flora species or Endangered Ecological Communities in relation to the provisions of the TSC Act or EPBC Act is considered necessary. It was also confirmed that there is no need for a referral under the EPBC Act.

Although the vegetation within the Project Site is not listed, the Project would involve the clearing of approximately 7.1ha of native vegetation. In order to mitigate against this impact a range of measures have been proposed including the establishment of an offset area and compensatory planting.

With the implementation of the proposed offset and compensatory planting, the Project would meet the DECCW's improve and maintain principles. Additionally, the offset would increase the security of the remnant vegetation in this locality.

4.4.7 Conclusion

Gingra (2010) concludes that the impact on native vegetation is relatively minor, given the disturbed nature of flora habitat present on the Project Site and the history of agricultural use prior to the commencement of quarrying. There are no significant constraints to the proposed development with respect to flora ecology.

4.5 FAUNA

4.5.1 Introduction

Based on the environmental risk analysis undertaken for the Project (see Section 3.3 and **Table 3.7**), the potential fauna impacts requiring assessment and their **unmitigated** risk rating are as follows.

- Disturbance leading to local extinction(s) (Extreme Risk).
- Disturbance leading to local population reduction (High Risk).
- Disturbance to Threatened fauna (Moderate Risk).
- Disturbance to fauna habitat within nominated areas (High Risk).
- Disturbance to fauna habitat outside nominated areas (Moderate Risk).

The following subsections describe the existing fauna habitat and fauna species within the Project Site and their conservation significance. The potential impacts that the Project would have on these fauna species are described together with the design and operational safeguards and management procedures to be employed.

The information presented in this section is drawn from the fauna assessment undertaken by Biodiversity Monitoring Services (BMS, 2010) whose full report is included in the *Specialist Consultant Studies Compendium* (Part 3). BMS (2010) has completed the assessment based upon previous field surveys undertaken by Central West Environmental Services (CWES), updated database searches and review of the flora assessment (see Section 4.4).

This subsection presents a summary of the contents of the fauna assessment report which includes details of the previous survey results.

4.5.2 Previous Surveys

The Project Site was initially surveyed by CWES in spring between 18 and 21 October 2003. Since that survey, the then Department of Environment and Conservation - Parks and Wildlife Division, now Department of Environment, Climate Change and Water (DECCW), released the draft *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004).

The results of the initial survey together with searches of relevant databases were used as a basis for the methodology for a second survey in accordance with the 2004 guidelines. The second field survey was carried out in early Autumn between 6 and 8 March 2007.

Fauna sampling techniques during the October 2003 survey involved the use of:

- 50 size "A" Elliot traps over three nights providing an equivalent of 150 trap nights;
- 20 size "B" Elliot traps over three nights providing an equivalent of 60 trap nights;
- four cage traps over three nights providing an equivalent of 12 trap nights;
- one Harp Trap set over two nights;
- Anabat recording over two nights;
- nocturnal call playbacks over two nights; and
- spotlighting over three nights.

Fauna sampling techniques during the March 2007 survey involved the use of:

- eight size "B" Elliott traps (arboreal) providing an equivalent of 16 trap nights;
- two Harp Traps set over two nights;
- nocturnal call playbacks over two nights;
- spotlighting over two nights; and
- Anabat recording over two nights;

Opportunistic identification of birds and bird calls and searching for sign of significant fauna was undertaken during both surveys and any additional species recorded.

A total of 25 bird, 16 native mammals, three introduced mammals and six reptiles were recorded by CWES during their surveys of the Project Site. Of these species, two (Flame Robin and Scarlet Robin) are listed as Vulnerable under the NSW TSC Act. A full list of recorded species is provided in BMS (2010).

4.5.3 Current Desktop Review

An updated search of the online Atlas of NSW Wildlife and EPBC Protected Matters Database was undertaken during May 2010 by BMS (2010) for the Oberon 1:100 000 map sheet. Threatened species within a radius of 20km and 50km from the Project Site were then determined to ensure the greatest coverage of potential Threatened species.

NSW Threatened Species Conservation Act 1995 Listed Species

Based on the online Atlas of NSW Wildlife search three mammal, 12 bird, two amphibian and one invertebrate species which are listed under the NSW TSC Act as either Vulnerable or Endangered are known from within 50km of the Project Site. In addition, two of these species are also listed as Vulnerable and two species as Endangered under the Commonwealth EPBC Act. The results of the search are provided in **Table 4.12**.

Table 4.12
TSC Act Threatened Species Known within 50km of the Project Site

Scientific Name	Common Name	Status
Mammals		
Petaurus australis	Yellow-bellied Glider	Vulnerable
Phascolarctos cinereus	Koala	Vulnerable
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	Vulnerable
Birds		
Oxyura australis	Blue-billed Duck	Vulnerable
Hieraaetus morphnoides	Little Eagle	Protected
Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable
Ninox strenua	Powerful Owl	Vulnerable
Climacteris picumnus	Brown Treecreeper	Vulnerable
Pyrrholaemus sagittatus	Speckled Warbler	Vulnerable
Xanthomyza phrygia	Regent Honeyeater	Endangered (+E)
Melanodryas cucullata	Hooded Robin	Vulnerable
Petroica boodang	Scarlet Robin	Vulnerable
Petroica phoenicea	Flame Robin	Vulnerable
Daphoenositta chrysoptera	Varied Sittella	Vulnerable
Stagonopleura guttata	Diamond Firetail	Vulnerable
Amphibians		
Litoria aurea	Green and Golden Bell Frog	Vulnerable (+V)
Litoria booroolongensis	Booroolong Frog	Vulnerable (+E)
Invertebrates		
Paralucia spinifera	Purple Copper Butterfly	Endangered (+V)
+V – Vulnerable under the Commonwealth EPBC Act, +E – Endangered under Commonwealth EPBC Act		
Source: Modified after BMS(2010) – Table 2		

Commonwealth Environment Protection and Biodiversity Act 1999 Listed Species

Based on the online Protected Matters Search, 12 migratory species, 20 threatened species and 12 Listed Marine Species are known from an area of 50km radius surrounding the Project Site. The results of the search are provided in **Table 4.13**.

Table 4.13
EPBC Act Threatened Species Known within 50km of the Project Site

Scientific Name	Common Name	Status
Migratory & Marine		
Haliaeetus leucogaster	White-bellied Sea-Eagle	Migratory, Listed Marine Species
Hirundapus caudacutus	White-throated Needletail	Migratory, Listed Marine Species (overfly)
Myiagra cyanoleuca	Satin Flycatcher	Migratory, Listed Marine Species (overfly)
Rhipidura rufifrons	Rufous Fantail	Migratory, Listed Marine Species (overfly)
Gallinago hardwickii	Latham's Snipe	Migratory, Listed Marine Species (overfly)
Rostratula benghalensis	Painted Snipe	Migratory, Listed Marine Species (overfly)
Merops ornatus	Rainbow Bee-eater	Migratory, Listed Marine Species (overfly)
Monarcha melanopsis	Black-faced Monarch	Migratory, Listed Marine Species (overfly)
Ardea alba	Great Egret	Migratory, Listed Marine Species (overfly)
Ardea ibis	Cattle Egret	Migratory, Listed Marine Species (overfly)
Xanthomyza phrygia	Regent Honeyeater	Endangered, Migratory
Lathamus discolor	Swift Parrot	Endangered, Listed Marine Species (overfly)
Birds		
Rostratula australis	Australian Painted Snipe	Vulnerable
Polytelis swainsonii	Superb Parrot	Vulnerable
Mammals		
Dasyurus maculatus ssp. *maculatus*	Spotted-tailed Quoll	Endangered
Petrogale penicillata	Brush-tailed Rock-wallaby	Vulnerable
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable
Nyctophilus timoriensis	Eastern Long-eared Bat	Vulnerable
Isoodon obesulus obesulus	Southern Brown Bandicoot	Endangered
Scientific Name	Common Name	Status
Potorous tridactylus tridactylus	Long-nosed Potoroo	Vulnerable
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable
Amphibians & Fish		
Eulamprus leuraensis	Blue Mountains Water Skink	Endangered
Hoplocephalus bungaroides	Broad-headed Snake	Vulnerable
Litoria aurea	Green and Golden Bell Frog	Vulnerable
Macquaria australasica	Macquarie Perch	Endangered
Prototroctes maraena	Australian Grayling	Vulnerable
Maccullochella peelii peelii	Murray Cod	Vulnerable
Invertebrates		
Paralucia spinifera	Purple Copper Butterfly	Vulnerable
Source: Modified after BMS (2010) – Table 4		

Corridors

No regional wildlife corridor mapping is known to have been undertaken within the Oberon area, however, the Project Site does occur within an approximately 85ha patch of remnant woodland vegetation. Based on review of available aerial photography, it is considered that the patch would not be of high importance at a regional scale although at a local scale the patch of woodland vegetation would provide habitat for more mobile species. It is not expected that the Project would significantly affect the significance of the remnant vegetation patch as a local wildlife corridor and any links with the riparian corridor associated with the Duckmaloi River would be retained. With the implementation of the proposed management measures (see Section 4.5.4), the long-term security of the remnant vegetation would in fact be improved.

State Environmental Planning Policy 44 – Koala Habitat

The Project Site was found to contain "Potential Koala Habitat" as defined by *State Environment Planning Policy 44* within the Project Site. This policy prohibits any council listed in Schedule 1 of the Policy, for which Oberon Council is listed, from granting development consent without first considering if the land to be affected is Koala (*Phascolarctos cinereus*) habitat. Schedule 2 of the SEPP also provides a list of known Koala food trees. One of the trees identified on the site, Ribbon Gum (*Eucalyptus viminalis*), exists in sufficient numbers for the site to be classified as "Potential Koala Habitat". However, it is not classified as "Core Koala Habitat" as CWES confirmed during surveys that no Koalas were observed, no scats or scratchings were found and there was no response to Koala call playback.

4.5.4 Safeguards and Mitigation Measures

The safeguards and mitigation measures outlines within Section 4.4.5 are equally applicable to fauna, including the establishment of the biodiversity offset and compensatory planting areas.

In addition to these measures it is proposed that a pre-clearance inspection would be undertaken prior to each vegetation clearing campaign to determine the presence of breeding/nesting native fauna within the disturbance area. This survey would be undertaken by inspection of trees from the ground and by searches for other evidence of nesting, particularly by threatened bird species.

4.5.5 Assessment of Impacts

Although the vegetation within the Project Site is not listed as critical habitat and has a history of disturbance, the Project would involve the clearing of approximately 7.1ha of native vegetation which is a key threatening process. In order to mitigate against this impact a range of measures have been proposed including the establishment of an offset area and compensatory planting. Furthermore, the extent of loss of woodland habitat as a consequence of the Project would be relatively low compared to the amount of woodland habitat in the surrounding area.

An assessment of impacts was completed by BMS (2010) for all Threatened and migratory recorded within 50km of the Project Site in accordance with Part 3A of the EP&A Act, the EPBC Act and relevant guidelines. Full details of the assessment of significance are provided in BMS (2010).

In summary, it was assessed that there would be no significant effects on any of the species identified as possibly being affected by the Project and that there are no significant constraints to the Project with respect to fauna habitat. It was also assessed that there is also no need for a referral under the EPBC Act.

4.5.6 Conclusion

BMS (2010) concludes that the Project would not result in a significant effect on any threatened or migratory species and that there are no significant constraints to the proposed development with respect to fauna.

4.6 TRANSPORTATION

4.6.1 Introduction

Based on the environmental risk analysis undertaken for the Project (see Section 3.3 and **Table 3.7**), the potential traffic and transportation impacts requiring assessment and their **unmitigated** risk rating are as follows.

- Increased traffic congestion (Moderate Risk).
- Road pavement deterioration (High Risk).
- Elevated risk of accident or incident on local roads (Moderate to High Risk).

The following subsections draw upon the traffic and transportation assessment prepared by Barnson (2010) and provides information on:

- the existing transportation network, including existing road classifications, traffic levels and safety considerations;
- the proposed management of traffic and operational safeguards; and
- an assessment of the potential impacts of the Project on the local road network and road users.

A full copy of Barnson (2010) is presented as Part 7 of the *Specialist Consultant Studies Compendium*.

4.6.2 Existing Transportation Network

Access to the Project Site would be via Hampton Road (MR558) and Ferndale Road. Hampton Road is an RTA controlled road on the main route from Oberon to Lithgow and Sydney. In the vicinity of the Project Site, Hampton Road is a sealed two lane road with approximately 0.5m wide gravel shoulders, reflector posts, centre line and shoulder markings and a legal speed limit of 100km/hr. Additionally, in the east-bound direction, a second lane is provided as a slow vehicle lane. This additional lane commences adjacent to the intersection of Ferndale Road (see **Plates 4.1** to **4.3**).

Plate 4.1 **Oblique Aerial View Westwards of Ferndale / Hampton Road Intersection (Ref: E709C-027)**

Plate 4.2 **View Eastwards along Hampton Road from the Ferndale Road Intersection (Ref: E709D-001)**

Plate 4.3 **View Westwards along Hampton Road from the Ferndale Road Intersection (Ref: E709D-002)**

Ferndale Road is a local Council controlled road providing access from Hampton Road to local properties and the existing quarry. Ferndale Road is a sealed two lane road with reflector posts and no line markings. The legal speed limit on Ferndale Road is 60km/hr. Ferndale Road was constructed by the Proponent in accordance with RTA local road standards before being dedicated as a public road. The road construction includes an 8m wide compacted base and sub-base (130mm/170mm respectively) and 6m wide 2 coat bitumen seal and a 40mm asphalt seal across the intersection with Hampton Road. It is noted that all materials and costs to construct the road were provided by the Proponent.

Barnson (2010) has determined the existing safe intersection sight distance for the intersection of Ferndale Road and Hampton Road is least 240m which exceeds AUSTROADS standards. The closest nearby intersection on Hampton Road is the Titania / Hampton Road intersection located approximately 600m directly to the west (approximately 800m by road).

An inspection of the current pavement condition of Hampton Road in the vicinity of Project Site and Ferndale Road indicates that the pavement is in good condition with no potholes, corrugation or other significant deformation.

4.6.3 Existing Traffic Volumes and Conditions

General traffic volume data from the RTA is available for Hampton Road at the Duckmaloi River bridge approximately 6.5km east of the Ferndale Road intersection. The latest traffic count data in 2007, indicates the average daily traffic volume was 1200 vehicles per day of which 19% constituted heavy vehicles (ie. 228 heavy vehicles per day). No traffic counts have been undertaken on Ferndale Road, however, it is considered that vehicle volumes would be low with heavy vehicle traffic predominantly related to the existing quarry.

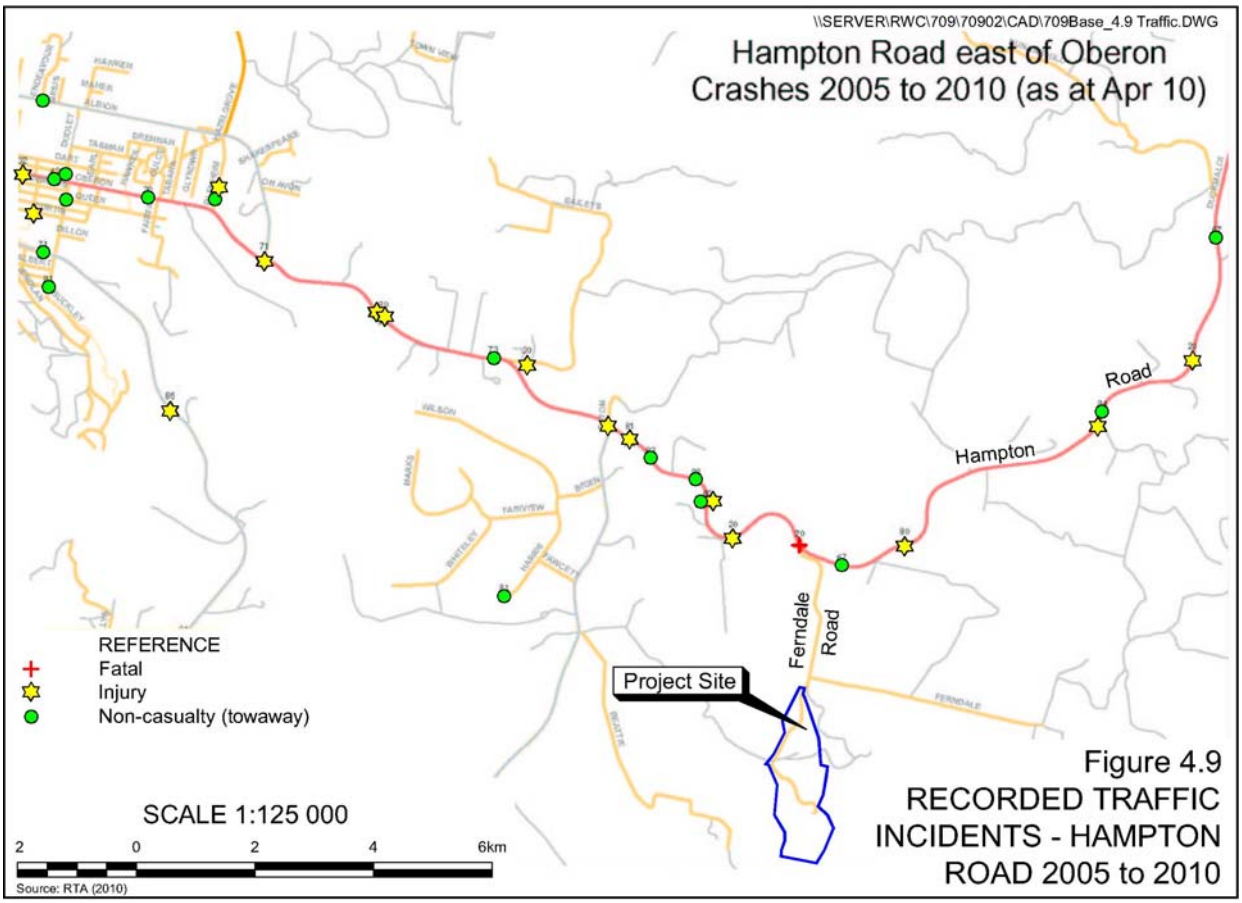
It is noted that a local school bus route operates on Hampton and Titania Roads near the Project Site. It is advised that, in the morning, the school bus leaves the Oberon township at approximately 7:30am travelling empty eastwards on Hampton Road to Jenolan Caves Road. The school bus then returns via Hampton Road collecting school children with the closest pick up / drop off point located approximately 4km east of Ferndale Road. The bus passes Ferndale Road at approximately 8:15am before turning left into Titania Road. There are no pick up / drop off points on Hampton Road between Ferndale Road and the Oberon township. In the afternoon, the school bus leaves the Oberon township at approximately 3:30pm heading eastwards on Hampton Road and initially turning right into Titania Road. The school bus then returns to Hampton Road heading eastwards passing Ferndale Road at approximately 3:50pm returning past Ferndale Road empty at approximately 4:20pm.

The reported accident history for Hampton Road together with Ferndale Road was also requested from the RTA. Data was provided for Ferndale Road and an approximately 25km length of Hampton Road between the Oberon township and the side road of Nunans Hill Road. In the 5 year period up to April 2010 there were no reported accidents on Ferndale Road and one fatal accident on Hampton Road and a number of accidents resulting in injury. It is noted that the fatal accident was recorded immediately to the west of the Ferndale Road intersection in 2009. The accident involved a west-bound light vehicle which lost control on loose gravel on the road shoulder before veering across double lines into eastbound traffic. Speed was recorded as a contributing factor. **Table 4.14** and **Figure 4.9** provide a summary the accident history data collated by the RTA for Hampton Road.

Table 4.14
Accident History – Hampton Road

Year	Degree of Crash[1]				Degree of Casualty[2]		
	F	IC	N	Total	K	I	Total
2010	0	0	0	0	0	0	0
2009	1	1	4	6	1	1	2
2008	0	5	3	8	0	5	5
2007	0	0	1	1	0	0	0
2006	0	3	1	4	0	3	3
2005	0	3	0	3	0	3	3

1. F – Fatal crash I C – Injury crash N – Non-casualty crash. 2. K – Killed I – Injured.
Source: RTA 2010



In addition to the minor upgrade works proposed for the Ferndale / Hampton Road intersection, as discussed in Section 2.7.2, the Proponent would adopt a range of safeguards and management procedures to ensure its vehicles and any sub-contractors' vehicles do not cause unacceptable impacts. These safeguards would include the following.

i) Supply of a "code of conduct" or similar to all drivers outlining the required conduct during the delivery of materials and details of the local school bus route and times. The code would require:

- all loads to be covered prior to exiting the quarry;
- all loaded trucks to exit the site over the weighbridge;

- minimisation of the use of exhaust breaks when travelling on Ferndale Road;
- truck drivers to be conscious of the school bus and school children, particularly during specified pick up / drop off times (details of which would be outlined within the code); and
- driving in a courteous and safe manner.

ii) Continued use of the 40km/hr speed limit for trucks whilst travelling along the site access road (including the right of carriageway).

iii) Transportation of materials would be restricted to between 6.00am and 6.00pm daily (Monday to Saturday) and 8.00am and 6.00pm (Sunday).

iv) Any overloaded trucks would be directed to unload a portion of their load to ensure that the vehicle mass remains within legal weight loadings.

v) Installation of reflector posts or similar, in consultation with the RTA, to allow the assessment of visibility during poor weather conditions such as fog.

4.6.5 Assessment of Impacts

Table 4.15 provides a summary of the projected traffic volumes on Hampton Road throughout the life of the Project and the percentage increase in total and heavy vehicle volumes that would occur as a result of the Project.

Table 4.15
Projected Traffic Volumes – Hampton Road

Year	Predicted Average Daily Traffic Volume[1]	Number of Heavy Vehicles[2]	Increase in Total Vehicles with Project[3]	Increase in Heavy Vehicles with Project[3]
2010	1290	245	5.9%	22.9%
2020	1651	314	4.6%	17.8%
2030	2114	402	3.6%	13.9%
2040	2706	514	2.8%	10.9%

Source: Modified from Barnson (2010) – Table 2.1

Notes: 1 – based on a conservatively high 2.5% annual increase in total traffic volume.
2 – assumes proportion of heavy vehicles remains consistent with currently recorded proportions.
3 – based on average of 56 daily truck movements and 20 light vehicle movements.

For the purposes of impact assessment, the following peak hourly traffic levels have been assumed.

- Product transport – 12 heavy vehicles movements (6 loads) per hour.
- Delivery vehicles – 2 heavy vehicle movements (1 return trip).
- Employees – 10 light vehicle movements.

As a worst case scenario, it has also been assumed that 100% of traffic movements occur to and from the east (towards Sydney).

Based on the Gap Acceptance Theory, Barnson (2010) has assessed that the average delay per vehicle will be less than 14 seconds with Hampton Road functioning at a Level of Service "A".[2] This level of service would be maintained over the life of the quarry with the predicted increases in ambient traffic levels.

Barnson (2010) also completed an assessment of the pavement design of Ferndale Road through the use of a CIRCLY analysis. The results of this analysis indicates that the pavement has a design capacity of 6×10^6 equivalent standard axles (ESAs) which is well in excess of the projected 1×10^6 ESAs projected for the 30 year life of the Project.

Given the proposed safeguards and procedures, it has been assessed that the Project would not significantly impact upon the safety or performance of the existing road network or the intersection of Ferndale and Hampton Roads.

4.7 NOISE AND VIBRATION

4.7.1 Introduction

Based on the environmental risk analysis undertaken for the Project (see Section 3.3 and **Table 3.7**), the potential noise impacts requiring assessment and their **unmitigated** risk rating are as follows.

- Increased noise levels associated with Project Site activities causing annoyance, distractions, ie. amenity impacts (Moderate to High Risk).
- Increased noise levels associated with Project-related road traffic activities causing annoyance, distractions, ie. amenity impacts (Moderate Risk).

The following subsections describe the existing noise environment surrounding the Project Site, environmental noise criteria, proposed operational safeguards and mitigation measures and an assessment of the residual impacts following the implementation of these safeguards and mitigation measures.

The information presented in this section is drawn from the noise assessment undertaken by Spectrum Acoustics (2010) whose full report is included in the *Specialist Consultant Studies Compendium* (Part 4). This subsection presents a summary of the contents of the noise assessment report.

4.7.2 Existing Noise Climate

Existing noise levels in the vicinity the Project Site are influenced by a number of sources including stock, birds, wind, insects, agricultural equipment and traffic along local roads. As there are no significant consistent noise sources in the area, the background noise level, that is, the lowest repeatable L_{A90} level, is likely to be less than 30dB(A). Previous background noise measurements undertaken for the existing quarry in September 2003 indicated that background noise levels varied between 26dB(A) and 29dB(A) (Atkins Acoustics, 2003).

[2] Level of Service is a qualitative measure describing operational conditions within a traffic stream and takes into account service measures such as speed and travel time, freedom to manoeuvre, traffic interruptions, safety, comfort and convenience. There are six levels of service, designated A (best – free flow) to F (worst – breakdown in flow) (Austroads, 2005)

4.7.3 Criteria for Impact Assessment

4.7.3.1 Noise

Construction Noise

During the site establishment phase of the Project, a number of activities have been considered as construction activities which should be assessed against relevant construction noise criteria provided within the Interim Construction Noise Guideline (DECC 2009).

The Interim Construction Noise Guideline provides for a construction noise criteria during standard hours of the Rating Background Level (RBL) plus 10dB(A). Therefore, the project specific construction criterion is 40dB(A) $L_{Aeq\ (15\ min)}$.

Operational Noise

In setting noise goals for a particular project, the *NSW Industrial Noise Policy 2000* (INP) considers both amenity and intrusiveness criteria. The amenity criterion is set to limit continuing increase in noise from more than one industrial source, whilst the intrusiveness criterion is set to minimise the intrusive impact of a particular noise source. Given that the Project Site and its surrounds are not subject to any existing industrial noise, intrusiveness criteria are applicable to setting the project specific noise goals.

The intrusiveness criterion, which limits the L_{Aeq} noise levels from industrial sources to the rating background level (RBL) plus 5dB(A). The RBL is defined as the overall single figure background level representing each assessment period (i.e. day/evening/night). The *NSW Industrial Noise Policy 2000* (INP) states that, where the RBL is found to be less than 30dB(A), then it is set to 30dB(A). Therefore, as the background noise level in the area is considered to be less than 30dB(A), for assessment purposes the RBL has been set as 30dB(A).

Based on the intrusiveness criterion, the project specific noise goal is 35dB(A) $L_{eq(15\ min)}$ and is applicable during all of the day, evening and night time periods.

This criterion is applicable to surrounding sensitive receivers, such as residences. In cases where landholdings do not have approved residences but retain dwelling entitlements, assessment is based upon exceedance of the criteria on no greater than 25% of the landholding.

Where exceedances are predicted to occur, exceedances of between 1 dB(A) and 5 dB(A) are often classed as a 'Noise Management Zone' whilst exceedances above 5 dB(A) are classed as a 'Noise Affectation Zone'.

For a noise management zone, it is recommended that management procedures be implemented including the following.

- Noise monitoring on-site.
- Prompt response to any community issues of concern.
- Refinement of on-site noise mitigation measures and operating procedures where practicable.
- Discussions with relevant landowners to assess concerns.

- Consideration of acoustical mitigation at residences where substantiated by monitoring results.
- Consideration of negotiated agreements with landowners.

Exposure to noise levels corresponding to a noise affectation zone (ie. >5dB(A) exceedances) may be considered unacceptable by some landowners. However, discussions with relevant landowners to assess concerns and define responses and implementation of acoustical mitigation at residences may be acceptable together with negotiated agreements. Alternatively, it may be appropriate an acceptable for the Proponent to acquire the affected residence / landholding.

Sleep Disturbance

Assessment of sleep interference by intermittent noise is required under the INP between the hours of 10:00pm to 7:00am. As the transport of materials may occur from 6:00am Monday to Saturday, it is necessary to assess the potential for short term elevated noises to cause disturbance to residents' sleep during night time hours.

In order to protect against people waking from their sleep, the DECCW recommends that 1-minute L1 noise levels (effectively, the L_{max} noise level from impacts, etc.) should not exceed the background level by more than 15dB(A) when measured/computed at the outside of a bedroom window. The "sleep disturbance" criterion is only applicable to night-time operations.

The sleep disturbance criterion at each receiver location is equal to the intrusiveness criteria plus 10dB(A), that is, 45 dB(A),$L_{1(1\text{-minute})}$, and applies to maximum noise emissions.

Road Traffic

Noise generated by project-related traffic on public roads is assessed separately to noise generated within the Project Site. The RTA's *Environmental Criteria for Road Traffic Noise* (ECRTN) recommends various criteria based on the functional categories of roads applied by the RTA. Vehicles would access the Project Site via Hampton and Ferndale Roads, both of which are considered as local roads under the definitions of the ECRTN.

Table 4.16 presents the noise criteria relevant to traffic on a local road extracted from Table 1 of the ECRTN. For the assessment of traffic noise, the day time period is from 7:00am to 10:00pm, whilst night is from 10:00pm to 7:00am.

Table 4.16
Road Traffic Noise Criteria

Situation	Recommended Criteria	
	Day - (7am–10pm)	Night - (10pm–7am)
8. Land use developments with potential to create additional traffic on local roads	Leq (1hr) 55	Leq (1hr) 50

The ECRTN also advises that, where criteria are already exceeded:

> *"In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2dB."*

4.7.3.2 Blasting

Noise and vibration levels from blasting are assessable against "annoyance" criteria proposed by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication "*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990"*. These criteria are summarised as follows.

- The recommended maximum overpressure level for blasting is 115dB (Linear).
- The level of 115dB (Linear) may be exceeded for up to 5% of the total number of blasts over a 12 month period, but should not exceed 120dB (Linear) at any time.
- The recommended maximum vibration velocity for blasting is 5mm/s Peak Vector Sum (PVS).
- The PVS level of 5mm/s may be exceeded for up to 5% of the total number of blasts over a 12 month period, but should not exceed 10mm/s at any time.
- Blasting should generally only be permitted during the hours of 9:00am to 5:00pm Monday to Saturday, and should not take place on Sundays and Public Holidays.
- Blasting should generally take place no more than once per day.

Criteria have also been developed based on issues related to building damage. However, as the annoyance criteria discussed above are significantly more stringent than the building damage criteria, the ANZECC annoyance criteria have been taken as the governing criteria for the proposal.

4.7.4 Operational Safeguards and Mitigation Measures

4.7.4.1 Noise

The following noise controls would be adopted throughout the life of the Project.

- An on-site weather station would be installed to enable assessment of adverse weather conditions and management of potentially noise intrusive activities.
- All immediately adjacent neighbouring residents or those potentially affected would be notified prior to the planned site establishment and subsequent vegetation clearing campaigns including the expected commencement and completion dates.
- Vegetation clearing campaigns would be restricted to between 9:00am and 5:00pm Monday to Friday.
- The crusher would, as far as practicable, be located behind product or raw material stockpiles to create additional acoustic shielding. This would be achieved by preferential stockpiling of products in the appropriate locations.
- Rock hammering would only be undertaken for up to 16 hours per month between 9:00am and 5:00pm Monday to Friday.

- No rock hammering would be undertaken during the operation of the drill rig or during vegetation clearing campaigns.
- All rock hammering would be undertaken on the quarry floor within 20m of the quarry face (for acoustic shielding purposes).
- The operation of the excavator would be restricted to the quarry floor during operation of the drill rig.
- The 6m acoustic bund would be maintained along the southern boundary of the extraction area.
- All mobile plant on site would use frequency modulated reversing alarms (as opposed to beeping reversing alarms).
- All plant and equipment on site would be regularly serviced to ensure no unnecessary noise emissions due to poor maintenance.
- The on-site road network would be regularly maintained to limit noise from the bodies of empty trucks travelling on the internal roads.
- Product trucks being loaded within the stockpile area would be preferentially loaded on the western side of the product stockpiles, particularly during early morning loading operations, to reduce received noise at the proposed residence EE.

The Proponent would also maintain dialogue with surrounding residents to ensure any concerns over site establishment and construction, operational or transport noise are addressed and noise controls adjusted appropriately.

4.7.4.2 Blasting

Blast designs for the Project would continue to build upon the experiences gained through the existing operation to reduce airblast (noise) and vibration impacts associated with blasts. The following parameters would continue to be assessed and modified as appropriate.

- The use of burden distance and stemming to ensure that explosion gases are almost completely without energy by the time they emerge into the atmosphere.
- Setting of charges in carefully designed sequences and with inter-row delays so as to consistently detonate and provide good progressive release of burden.
- Use of appropriate stemming materials, eg. 20mm aggregates.
- Limitation of the maximum weight of explosive detonated in a given delay period (the maximum instantaneous charge (MIC)) to conservative and proven levels.
- Monitoring of all blasts would be monitored (see Section 4.7.7.2) and the blast design optimised as required to minimise adverse impacts.

The Proponent would continue to notify residents and landholders within a 2km radius of the quarry prior to each blast and maintain a blast notification board at the entrance to the Project Site. Based on feedback from consultation undertaken during preparation of the *Environmental*

Assessment, the Proponent would also maintain dialogue with surrounding residents and landowners and establish the most convenient and reliable blast notification system for each resident (eg. via letter, email, SMS etc.).

4.7.5 Assessment of Noise Impacts

4.7.5.1 Assessment Methodology

Operational Noise

Sound power levels of the major noise sources were drawn from the library of technical data maintained by Spectrum Acoustics which contains data for similar plant items in typical operating conditions – see **Table 4.17**. The noise levels shown are for the various noise sources as an L_{eq} over a 15 minute period except impact noise used to assess sleep which is expressed as an L_{max}. It is also noted that, to consider the worst case, the excavator, drill rig and crushing plant were all considered to be producing the maximum sound power level for the entire 15 minute assessment period.

Table 4.17
Modelled Sound Power Level and Frequency Spectra of Major Noise Sources (as $L_{eq\ 15mins}$)

	Frequency (Hz)									
Item	**dB(A)**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Cat D9 Dozer	114	74	112	118	109	111	108	108	102	95
Cat 980 FEL	107	110	113	109	106	103	101	98	94	90
30t Excavator	107	104	112	114	106	106	103	99	96	92
Water Cart	99	102	104	96	91	90	94	95	87	81
Grader	97	95	105	99	94	93	92	88	82	74
30t Haul Truck	105	99	102	98	102	102	102	98	93	85
Drill Rig	119	109	101	108	99	104	106	112	115	112
Crushing Plant	114	108	125	120	111	111	109	106	102	95
Road Truck	98	87	93	95	96	92	90	85	80	67
Rock Hammer	120	110	106	112	122	117	116	107	105	101
Impact noise*	$120L_{max}$	-	99	100	110	113	114	114	110	100

Source: Spectrum Acoustics (2010) – Tables 5 and 6
*Assumed noise source used to assess potential sleep disturbance

Assessment of operational noise was conducted using RTA Technologies Environmental Noise Model (ENM) v3.06. Noise modelling was carried out for site establishment activities (Year 1), vegetation clearing campaigns and normal quarry operations at Years 5, 10, 15 and 20 under the following atmospheric conditions.

- ***Calm*** – 20^0C, 70% R.H., no wind (neutral atmospheric).
- ***South-southeast*** - 20^0C, 70% relative humidity, 3m/s wind from the south-southeast (157.5°).
- ***East-northeast*** - 20^0C, 70% relative humidity., 3m/s wind from the north-northeast (67.5°).

A scenario under these atmospheric conditions was also included to assess the potential noise impacts resulting from the use of the rock hammer.

An additional scenario was also undertaken to assess potential noise impacts from loading of product trucks and transportation of material before 7:00am under temperature inversion (noise enhancing) conditions. The atmospheric conditions within this scenario were as follows.

- ***Temperature Inversion*** - 20°C, 70% relative humidity and +3°C/100m temperature gradient.

The location of equipment included within each modelled scenario is provided on **Figure 4.10**. A full description of the modelled noise scenarios including details of modelled activities is provided in Spectrum Acoustics (2010).

Road Traffic

The methodology used to assess road traffic noise (as apart from traffic on site which has been included within the operational scenarios) was sourced from the commonly accepted US Environmental Protection Agency Document No. 550/9-74-004 *Information on levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* dated March 1974.

The sound power levels of trucks (including both laden and unladen semi-trailers and B-Doubles) were sourced from Spectrum Acoustics' library of technical data. Based on the estimated daily peak truck movements, up to 6 truck loads (12 movements) per hour could occur between 6:00am and 8:00am and 2:00pm to 4:00pm Monday to Friday.

Received noise was calculated on the basis of half of the vehicles being in the near lane of traffic and half in the far lane, with the total being the logarithmic addition of the two levels. In order to assess the worst case, all laden trucks were considered to travel in the same direction, eg. eastwards along Hampton Road towards Sydney.

The traffic noise assessment has been undertaken to calculate the minimum distance a receiver must be from the edge of the near lane of traffic to achieve compliance with the noise criteria for a local road (see **Table 4.16**).

4.7.5.2 Results

Construction and Operational Noise

Figures 4.11 and **4.12** present noise contours the site establishment scenario and normal operations during Year 20 of the Project. A full set of noise contour plans are presented in Spectrum Acoustic (2010). **Table 4.18** presents the point-to-point calculations for the modelled scenarios where potential exceedances of the 35dB(A) criterion are predicted at surrounding residences. It is noted that the results of the point-to-point calculations can be seen to vary slightly from the contours and is due to the manner in which the ENM noise model undertakes the various modelling procedures. Point-to-point calculations are carried out to a specific ground location, whereas the contours are an interpolation of noise values between arbitrary radial calculation points. For this reason, the point-to-point calculations are considered more accurate and the contours should be viewed as indicative only.

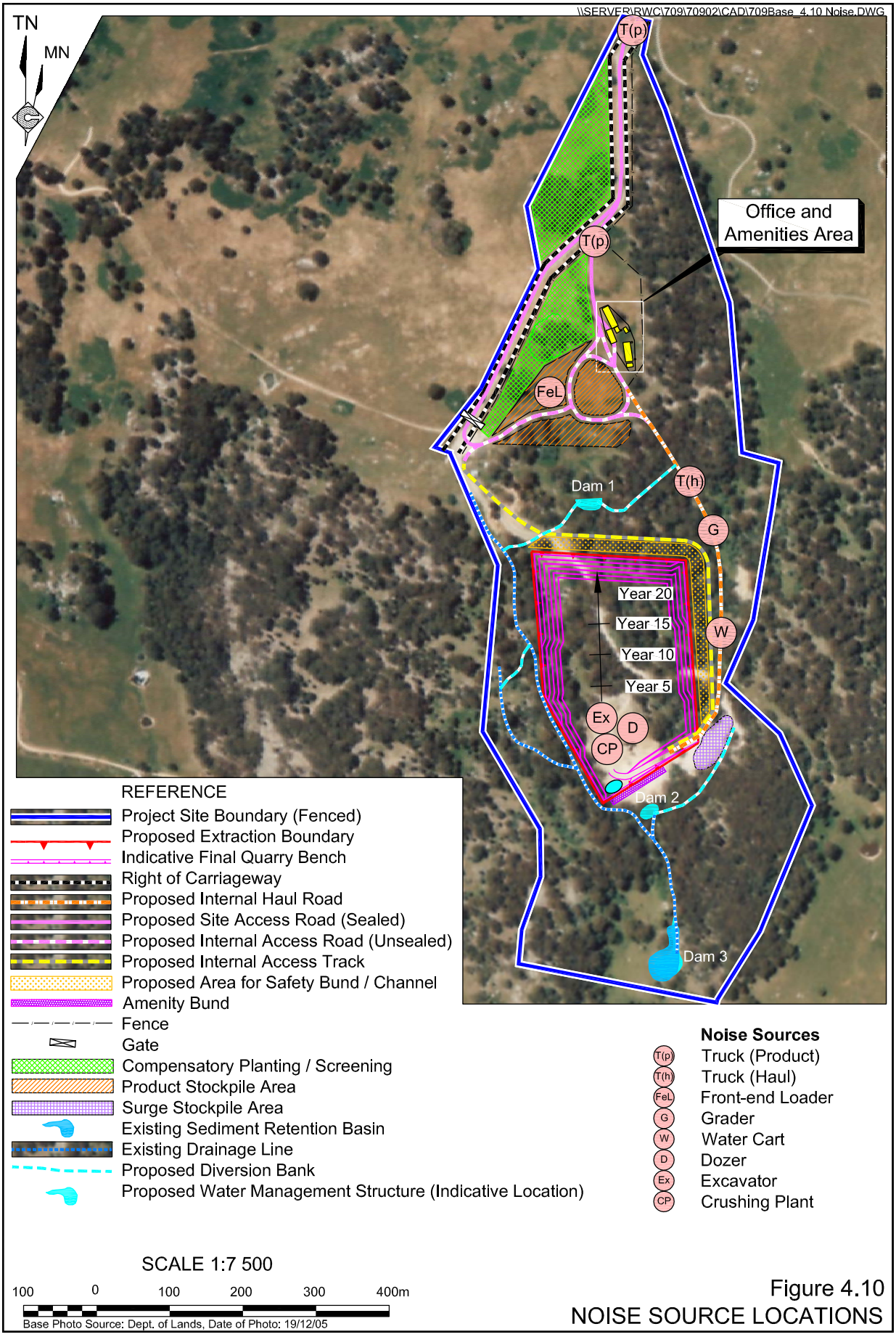


Figure 4.10
NOISE SOURCE LOCATIONS

Table 4.18
Point-to-Point Calculation Results ($dB(A)_{Leq(15min)}$)

Year	Operating scenario	Atmospheric conditions	Residence*	Noise Level	Major Sources
1	Site estab.	Calm	O	37.0	Dozer
1	Site estab.	Calm	EE	41.4	Dozer
1	Site estab.	ENE wind	C	38.4	Dozer
1	Site estab.	ENE wind	O	37.2	Dozer
1	Site estab.	ENE wind	W	35.7	Dozer
1	Site estab.	ENE wind	A	35.8	Dozer
1	Site estab.	ENE wind	EE	38.1	Dozer
1	Site estab.	SSE wind	EE	39.9	Dozer
5	Veg clearing	Calm	EE	40.0	Dozer
5	Veg clearing	ENE wind	C	37.9	Dozer
5	Veg clearing	ENE wind	EE	36.6	Dozer
5	Veg clearing	SSE wind	EE	38.7	Dozer
10	Veg clearing	Calm	EE	40.5	FEL
10	Veg clearing	ENE wind	C	35.2	Dozer
10	Veg clearing	ENE wind	EE	39.0	Dozer
10	Veg clearing	SSE wind	EE	41.2	FEL
15	Veg clearing	Calm	EE	40.5	FEL
15	Veg clearing	ENE wind	C	38.4	Dozer
15	Veg clearing	ENE	EE	39.2	Dozer
15	Veg clearing	SSE wind	R	35.8	FEL
15	Veg clearing	SSE wind	EE	42.0	FEL
20	Veg clearing	Calm	EE	41.8	FEL
20	Veg clearing	ENE wind	C	38.5	Dozer
20	Veg clearing	ENE wind	EE	37.9	FEL
20	Veg clearing	SSE wind	EE	41.8	FEL
5	Operations	Calm	EE	41.4	FEL
5	Operations	ENE wind	EE	38.4	FEL
5	Operations	SSE wind	EE	41.0	FEL
10	Operations	Calm	EE	41.4	FEL
10	Operations	ENE wind	EE	38.4	FEL
10	Operations	SSE wind	EE	41.0	FEL
15	Operations	Calm	EE	41.5	FEL
15	Operations	ENE wind	EE	38.5	FEL
15	Operations	SSE wind	EE	41.2	FEL
20	Operations	Calm	EE	41.4	FEL
20	Operations	ENE wind	EE	38.4	FEL
20	Operations	SSE wind	EE	41.0	FEL

Source: Spectrum Acoustics (2010) – Table 8 *see **Figure 4.3**

The results indicate that exceedances of operational criteria of less than 5dB(A) are predicted to occur only during site establishment and vegetation clearing activities. As can be seen, residences which are located close to the Project Site, particularly residences A, B, U and BB, have been effectively shielded by their proximity to the intervening topography. Residences which are further removed are afforded less protection from this topographic shielding.

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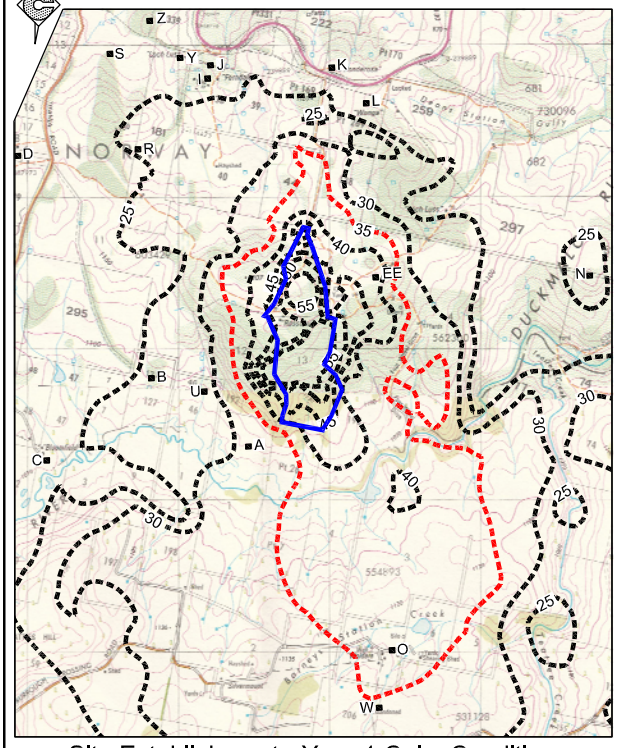
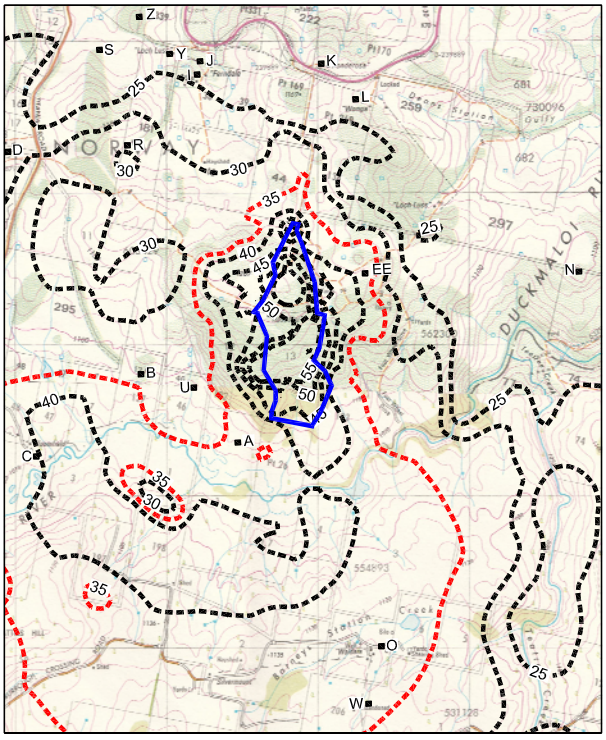
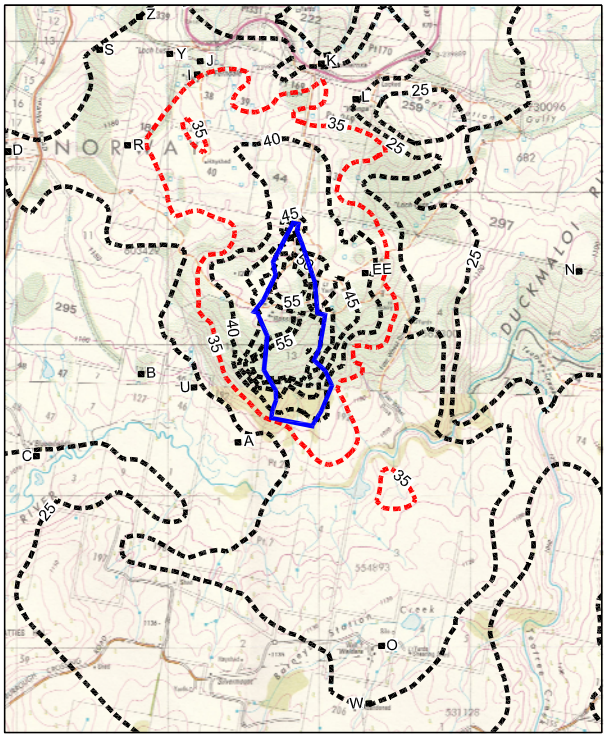


Site Establishment - Year 1 Calm Conditions



Site Establishment - Year 1 East North East Wind



Site Establishment - Year 1 South South East Wind

REFERENCE
Project Site Boundary
Noise Contour dB(A)
N■ Residential Location (Approximate)

SCALE 1:50 000

0.5 0 0.5 1.0 1.5 2.0 2.5 km

Source: Spectrum Acoustics (2010) - Figures 6,7 & 8

Figure 4.11
NOISE CONTOURS
(SITE ESTABLISHMENT)

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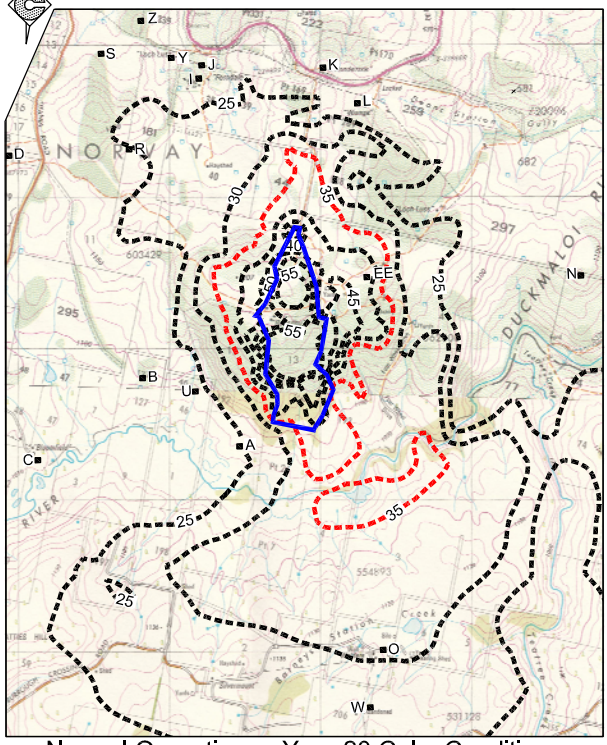
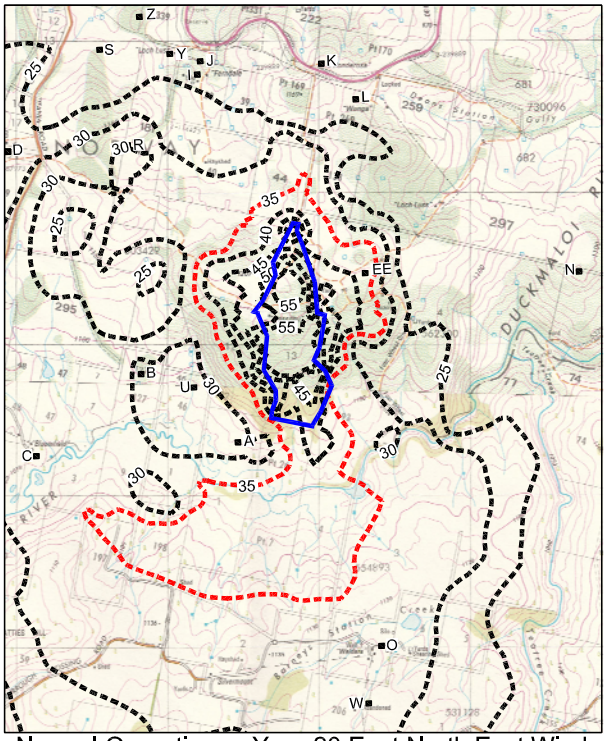
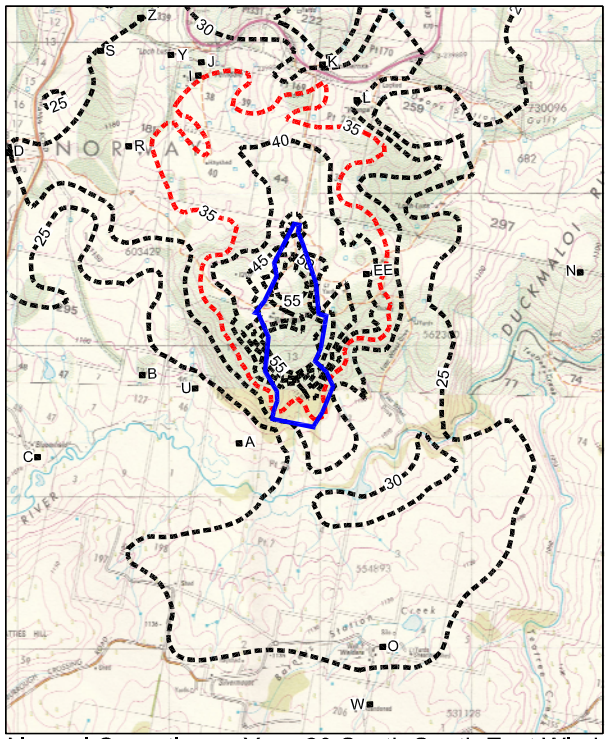
TN
MN



Normal Operations - Year 20 Calm Conditions



Normal Operations - Year 20 East North East Wind



Normal Operations - Year 20 South South East Wind

REFERENCE
Project Site Boundary
Noise Contour dB(A)
N■ Residential Location (Approximate)

SCALE 1:50 000

0.5 0 0.5 1.0 1.5 2.0 2.5 km

Source: Spectrum Acoustics (2010) - Figures 30,31 & 32

Figure 4.12
NOISE CONTOURS
(NORMAL OPERATIONS - YEAR 20)

In relation to residence EE, an agreement is in place with the owner and predicted exceedances are below the agreed maximum levels. Therefore, no further assessment has been undertaken at this residence.

Excluding residence EE, the major noise source on all but two occasions is the Dozer when winds are from the east-northeast. Therefore, in order to minimise the potential for these noise exceedances, the dozer would not operate in exposed areas whilst the winds are from directions ranging from the north-northeast to east-southeast at speeds between 1m/s and 4m/s. Although these winds are prevailing, annually they occur for less than 30% of the time (see **Figure 4.2**). This would be managed through the installation of an on-site weather station. Wind speeds greater than 4m/s result in a general increase in environmental noise that would effectively mask any noise from the quarry.

As the site establishment and vegetation clearing is only a relatively short term activity managing this activity to avoid these atmospheric conditions should be readily achieved. It is also noted that noise emissions from construction works of the same duration as the site establishment activities would have a noise criterion of "background plus 10dB(A)" ie. 40dB(A). Therefore site establishment activities would comply with the relevant construction criteria. Additionally, the operation of the dozer would be restricted to between 9:00am to 5:00pm Monday to Friday, well within the recommended standard construction work hours of 7:00am to 6:00pm Monday to Friday and 8:00am to 1:00pm Saturday (DECC 2009).

No exceedances were predicted at any surrounding residence under normal quarry operations or during the use of the rock hammer when implementing the management procedures outlined in Section 4.8.4.

The assessment of potential sleep disturbance impacts resulting from early morning (6:00am to 7:00am) loading and transportation activities indicates that the sleep disturbance criterion would not be exceeded as a result of the modelled L_{max} noise emissions from the quarry.

In addition to the assessment of predicted noise levels at surrounding residences, an assessment of the potential impacts of noise was also undertaken for the vacant landholding adjoining the western boundary of the Project Site owned by H.R & S.P Webb. It is understood that this landholding has dwelling potential, however, building approval has previously been refused (see Section 4.1.4.3) and as such no building envelope is specified. Therefore, assessment has been undertaken using the accepted criteria whereby noise levels should not exceed the criterion on greater than 25% of the landholding.

Table 4.19 provides a summary of scenarios where noise is predicted to exceed relevant criterion over 25% of the landholding.

Noise exceedances of up to 5dB(A) (a noise management zone) are predicted to occur on greater than 25% of the landholding during all scenarios except early morning transport. Numerous exceedances of greater than 5dB(A) (a noise affectation zone) are also predicted. It is important to note that the modelled noise scenarios are considered to be typical worst case at maximum production and therefore the predicted noise levels would not be likely to occur during the initial years of operation or on a continuous basis. Additionally, there are several viable building envelopes within the landholding which are suitable for a dwelling and would not receive noise levels above 35dB(A) under any of the modelled conditions.

Table 4.19
Contour Calculations ($dB(A)_{Leq(15min)}$)

Year	Operating scenario	Atmospheric conditions	% of land where levels exceed 35dB(A)	% of land where levels exceed 40dB(A)
1	Site Establishment	Calm	57.5%	32%
1	Site Establishment	ENE Wind	80%	48%
1	Site Establishment	SSE Wind	65%	35%
5	Veg Clearing	Calm	46%	30%
5	Veg Clearing	ENE Wind	69%	44%
5	Veg Clearing	SSE Wind	54%	32%
5	Normal Operations	Calm	28%	8%
5	Normal Operations	ENE Wind	49%	26%
5	Normal Operations	SSE Wind	29%	8%
10	Veg Clearing	Calm	43%	25%
10	Veg Clearing	ENE Wind	62%	40%
10	Veg Clearing	SSE Wind	46%	25%
10	Normal Operations	Calm	33%	15%
10	Normal Operations	ENE Wind	51%	30%
10	Normal Operations	SSE Wind	32%	13%
15	Veg Clearing	Calm	47%	30%
15	Veg Clearing	ENE Wind	69%	46%
15	Veg Clearing	SSE Wind	50%	31%
15	Normal Operations	Calm	37%	20%
15	Normal Operations	ENE Wind	56%	36%
15	Normal Operations	SSE Wind	38%	19%
20	Veg Clearing	Calm	43%	28%
20	Veg Clearing	ENE Wind	66%	44%
20	Veg Clearing	SSE Wind	44%	27%
20	Normal Operations	Calm	37%	21%
20	Normal Operations	ENE Wind	54%	35%
20	Normal Operations	SSE Wind	37%	18%
5	Rock Hammering	Calm	45%	19%
5	Rock Hammering	ENE Wind	76%	35%
5	Rock Hammering	SSE Wind	51%	20%
-	Transport early morning	Tem inversion	16%	3%

Source: Spectrum Acoustics (2010) – Table 9

The Proponent is committed to undertake regular ongoing monitoring of quarry operations to verify the predicted exceedances (see Section 4.6.7). In the event that any recorded exceedances cannot be avoided through the implementation of additional practicable management measures, the Proponent would seek an agreement with the landowner involving compensation for the verified exceedances or acquisition of the landholding or part thereof. It is noted that the Proponent has previously offered to purchase H.R & S.P Webb's landholding on several occasions but has been declined.

Road Traffic

Table 4.20 shows the results of the traffic assessment based on a worst case scenario of 12 truck movements in an hour. Vehicles were assumed to be travelling at an average speed of 90km/hr.

Table 4.20
Traffic Noise – Hampton Road

Typical Operating Sound Power, @ 90 km/hr dB(A)	108
Distance Loss to Receiver	28 (10m)
Received Maximum Noise dB(A)	80
Traffic Volume, (vehicles/hr)	12
Time each vehicle audible at 90 km/hr (mins)	0.04
Background Noise Level dB(A)	30
Calculated Traffic Noise, dB(A)(Leq 1 hr)	55
Criteria dB(A) (Leq 1 hr)	55
Source: Spectrum Acoustics (2010) – Table 10	

Project-related heavy vehicles travelling on public roads may be audible at nearby residences, as is the case with existing traffic travelling along these roads, however, **Table 4.20** shows that traffic noise levels on Hampton Road would be below the day time criterion at the façade of all receivers greater than 10m from the edge of the near lane of traffic and the night time criterion at the façade of all receivers greater than 30m from the near lane of traffic. Based on aerial photography, between the quarry and the Oberon township and Jenolan Caves Road no residences are known to be situated within 10m or 30m of Hampton Road and are generally well in excess of 30m from Ferndale Road.

4.7.6 Assessment of Blast Impacts

4.7.6.1 Assessment Methodology

Unweighted airblast overpressure levels (OP) were predicted using the following equations.

OP = 165 – 24(log_{10}(D) – 0.3 log_{10}(Q)),dB

where: *D* is distance from the blast to the assessment point (m) and

Q is the weight of explosive per delay (kg).

Blast (Ground) Vibration levels calculated as Peak Particular Velocity Blasting were predicted using the following equations.

$$PPV = 1140\left(\frac{D}{Q^{0.5}}\right)^{-1.6}$$ ***, mm/s (for average ground type)***

$$PPV = 500\left(\frac{D}{Q^{0.5}}\right)^{-1.6}$$ ***, mm/s (for hard rock)***

where: *D* is distance from the blast to the assessment point (m) and

Q is the weight of explosive per delay (kg).

4.7.6.2 Results

The nearest existing residence to the blasting will be at Residence "A" (see **Figure 4.3**) which is located approximately 560m to the southwest of the closest point of the extraction area. Substituting various representative distances and an MIC of 100kg, to approximate a worst case, into the equations presented in Section 4.8.6.1 results in overpressure and vibration impacts as shown in **Table 4.21**.

Table 4.21
Predicted Blast Noise and Vibration Levels

Distance	Vibration PPV (mm/s)	Overpressure dB Linear
500m	0.95	114
750m	0.50	110
1000m	0.31	107
1500m	0.16	103
2000m	0.10	100
Source: Modified after Spectrum Acoustics (2010) – Table 11 PPV – Peak Particle Velocity		

The results in **Table 4.21** indicate that received noise and vibration levels from typical blasting operations would be significantly below the relevant criteria at the nearest receiver. As all other receivers are more distant from the quarry, further assessment of impacts at these receivers is not considered warranted. It is however, noteworthy that it is likely blasts would be heard at distances of at least 2km from the quarry with the "noise" or overpressure level well below the criterion.

In regards to fly rock, it is the Proponents experience that fly rock would be limited to an envelope of up to 40m behind the blast and 100m in front of and to the side of the blast. With the implementation of the appropriate safeguards (see Section 4.7.4), there would be no fly rock issues beyond the boundaries of the Project Site.

4.7.7 Monitoring

4.7.7.1 Noise

It is proposed that attended noise monitoring be undertaken at representative surrounding residences in consultation with the DECCW and local residents. Although no exceedances of construction noise criteria are predicted, during site establishment monitoring would be undertaken during construction of the site access roads. Following site establishment, monitoring of extraction and processing campaigns should continue on an annual basis and during each vegetation clearing campaign (approximately every 5 years).

It is important that the noise monitoring conducted is regularly reviewed to ensure the data being collected are meaningful. The Proponent should keep detailed records of all Project Site activities during the period of monitoring to provide a basis for evaluating compliance and/or identifying potential sources of any noise goal exceedances.

Attended noise monitoring would be undertaken at representative surrounding residences and on the vacant landholding owned by H.R & S.P Webb in consultation with the DECCW and local residents / landholders. Monitoring would be undertaken during the initial site establishment activities and then subsequently on an annual basis during extraction and processing campaigns. Monitoring of each vegetation clearing campaign would also be undertaken. Details of all site activities and meteorological conditions during the monitoring period would be recorded to provide a basis for evaluating compliance and/or identifying potential sources of any noise goal exceedances.

All monitoring results would be provided to the respective resident / landholder and reported within each Annual Environmental Management Report.

In the event that monitoring indicates exceedances of applicable criteria during normal operations, investigations into additional management measures would be undertaken in consultation with the relevant resident / landholder and additional monitoring undertaken to verify the success of these measures.

Details of the monitoring procedures and noise monitoring locations would be provided in the Noise Monitoring Plan prepared for the Project, following the receipt of project approval.

4.7.7.2 Blasting

All blasts would continue to be monitored within the Project Site and at selected, potentially most affected residences using a blast vibration / overpressure monitor. Additional monitoring would also be undertaken at other residences upon request. Monitoring results would be provided to the respective resident / landholder and relevant government agencies.

Details of the monitoring procedures and noise monitoring locations would be provided in the Noise Monitoring Plan prepared for the Project, following the receipt of project approval.

4.7.8 Conclusion

Although some exceedances of noise criteria are predicted during the brief periods of vegetation clearing, with the implementation of appropriate management measures, it has been assessed that compliance with relevant criteria during all stages of operation can be achieved at all surrounding residences. Some exceedances of noise would be experienced on the adjacent vacant landholding, however, the Proponent would remain proactive in undertaking monitoring, identifying any additional practical mitigation measures or seeking an agreement with the landowners.

Based on the assessment completed by Spectrum Acoustics (2010) is concluded that, with the implementation of the recommended management measures, the Project meets the principles of the INP.

4.8 AIR QUALITY

4.8.1 Introduction

Based on the environmental risk analysis undertaken for the Project (see Section 3.3 and **Table 3.7**), the potential air quality impacts requiring assessment and their **unmitigated** risk rating are as follows.

- Deposited dust levels attributable to the Project occasionally (for one or two months every year) above DECCW guideline, affects only adjacent landholders (High Risk).
- Deposited dust levels attributable to the Project regularly (exceedances greater than DECCW guideline for >5 months per year) affects landholders some distance from the Project Site (High Risk).
- PM_{10} levels attributable to the Project occasionally (once every 1 to 2 years) above the Project goal, affects only adjacent landholders (Moderate Risk).
- PM_{10} levels attributable to the Project occasionally (>5 times per year) above the Project goal, affects landholders some distance from Project Site (Moderate Risk).
- Greenhouse gas emissions (Moderate risk).

The following subsections describe the existing air quality environment surrounding the Project Site, air quality criteria, proposed operational safeguards and mitigation measures and an assessment of the residual impacts following the implementation of these safeguards and mitigation measures.

The information presented in this section is drawn from the air quality assessment undertaken by Heggies Pty Ltd (Heggies, 2010) whose full report is included in the *Specialist Consultant Studies Compendium* (Part 5). This subsection presents a summary of the contents of the air quality assessment report.

4.8.2 Air Quality Goals

4.8.2.1 Goals Applicable to Particulate Matter Less than 10 Microns (PM_{10})

Emissions of PM_{10}, particulate matter less than 10µg/m^3 are considered important pollutants in terms of impact due to their ability to penetrate into the respiratory system. Potential adverse health impacts associated with exposure to PM_{10} include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The NSW DECCW PM_{10} assessment goals as expressed in their document *"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales"* (2005) are:

- a 24-hour maximum of 50µg/m^3; and
- an annual average of 30µg/m^3.

4.8.2.2 Goals Applicable to Total Suspended Particulate Matter

The annual goal for Total Suspended Particles (TSP) is given as 90µg/m^3, as recommended by the National Health and Medical Research Council (NHMRC) in 1981.

It is noted that the PM_{10} sub-set is typically 50% of TSP mass in regions where road traffic is not the dominant particulate source (USEPA, 2001). This would be consistent with an annual average PM_{10} goal of approximately 45µg/m^3 (derived from 50% of the annual NHMRC goal of 90µg/m^3). Thus, the historical NHMRC goal may be regarded as not as stringent as the newer PM_{10} goal of 30µg/m^3 expressed as an annual average.

As the annual TSP goal is seen to be achieved if the annual PM_{10} goal is satisfied, TSP has not been considered further in this document.

4.8.2.3 Nuisance Impacts of Fugitive Emissions

The preceding sections are concerned largely with the health impacts of particulate matter, however, nuisance impacts also need to be considered, mainly in relation to dust deposition. In order to avoid dust nuisance, the DECCW has developed assessment goals for dust fallout. **Table 4.22** presents the allowable increase in dust deposition relative to the ambient levels.

Table 4.22
DECCW Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2g/m^2/month	4g/m^2/month
Source: Heggies (2010) – Table 4		

In the absence of existing background data, the incremental increase can become the governing goal.

4.8.2.4 Project Site Air Quality Goals

The air quality goals adopted for the Project are consistent with those specified in the NSW DECCW targets. In summary, the specific goals being applied at surrounding receptors are as follows.

PM_{10}: A 24-hour maximum of 50µg/m^3.
An Annual average of 30µg/m^3.

Dust: An incremental annual average dust deposition level of 2g/m^2/month.
A total annual average dust deposition level of 4g/m^2/month.

Similar to noise, where a sensitive receptor is not located on a non-Project related landholding which holds potential dwelling entitlement, the DoP typically mandate that the Project goals (as above) should not be exceeded on more than 25% of any privately-owned land. The approach has been used to assess the privately owned land holding (owned by H.R & S.P Webb) located adjacent the western boundary of the Project Site.

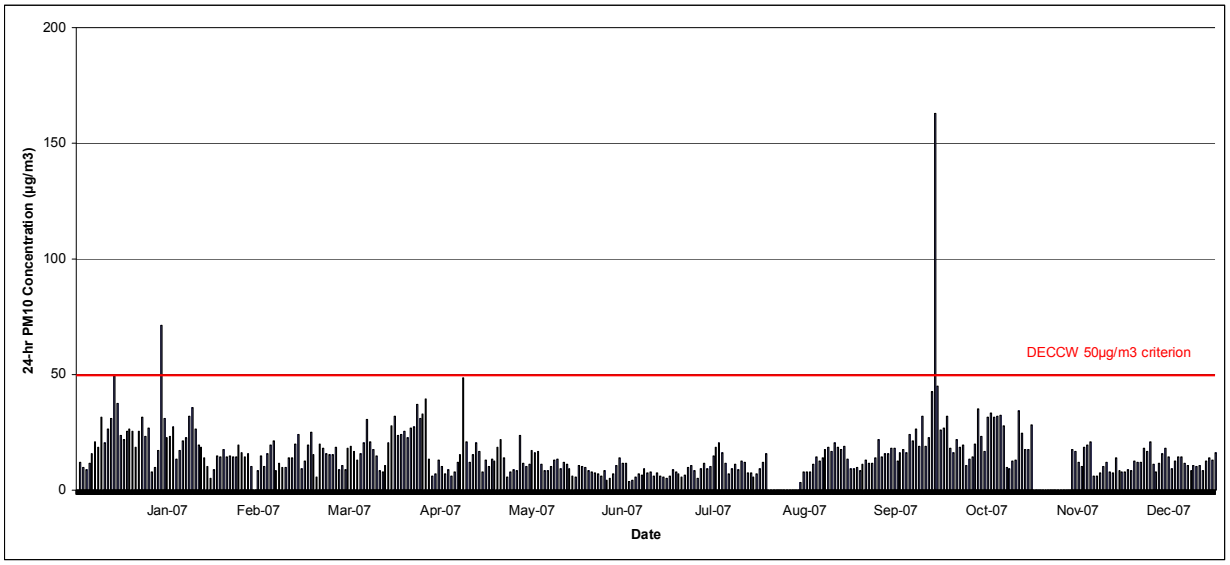
4.8.3 Existing Air Quality

Air quality standards and goals refer to total pollutant levels from both existing sources and proposed activities. To fully assess impacts against all the relevant air quality standards and goals, it is therefore necessary to have information or estimates on existing airborne, and dust deposition levels.

In the absence of local data, the closest NSW DECCW air quality monitoring station, located in Bathurst approximately 50km to the northwest of the Project Site, was chosen as the most representative data available for assessment of background fine particulate conditions.

The verified data for 2007 showing 24-hour average PM_{10} (particulate matter less than 10µm in diameter) concentration at the Bathurst monitoring site is presented in **Figure 4.13**.

Figure 4.13
24 Hour Average PM_{10} Concentration (µg/m^3) Bathurst 2007



It is noted that two exceedances of the DECCW criterion occurred during 2007, the highest exceedance of 156.7µg/m^3 recorded on 2 October 2007 and the second exceedance of 71.1µg/m^3 was recorded on 27 January 2007 both understood to have been caused by a bushfire and localised dust storm.

Based on the available data, the annual average background PM_{10} has been calculated to be 16.0µg/m^3 and an annual average total suspended particulates (TSP) of 32.0µg/m^3.

In the absence of relevant background monitoring data for dust deposition, a background value of 2g/m^2/month can be adopted to reflect a conservatively high estimation of rural conditions for NSW.

In summary, the adopted site-specific air quality background levels for the air quality assessment are presented in **Table 4.23**.

Table 4.23
Background Air Quality Environment for Assessment Purposes

Air Quality Parameter	Averaging Period	Assumed Background Level
TSP	Annual	32.0µg/m^3
PM_{10}	24-Hour	Hourly varying [1]
	Annual	16.0µg/m^3
Dust	Annual	2g/m^2/month

Note 1: Hourly varying 24-hour average PM_{10} concentrations are to be used for modelling purposes.
Source: Heggies (2010) – Table 3

4.8.4 Safeguards and Management Measures

The Proponent would adopt the following safeguards and management procedures to limit the generation of dust from site activities.

- The mobile crushing plant would be located within the extraction area which provides topographical shielding from the effects of winds.
- Dust suppression sprays would be fitted to the crushing plant.
- A 10 000L water truck would be used to wet the active internal unsealed roads when trucks are planned to travel on those roads. For those days when watering of unsealed roads is required, watering would occur with an application rate of approximately 2L/m^2 per application. The water truck would be filled from either the quarry sump or Dam 2.
- Progressive rehabilitation of disturbed areas, wherever practicable, to reduce the disturbed area exposed to wind erosion.
- The drop heights between front-end loader buckets and trucks carrying raw materials, products or soil would be minimised through operator training and education on the management of dust.
- The drill rig used for drilling and blasting would utilise water injection or alternatively, be fitted with dust collectors.
- Avoid, where possible, blasting in strong winds from the eastern quadrant that may increase short term dust exposure for nearby sensitive receptors.

The safeguards and management procedures would be reviewed annually and any required changes to the dust management strategies would be adopted.

4.8.5 Assessment Methodology

Computer predictions of fugitive emissions from the Project Site were undertaken using the Ausplume Gaussian Plume Dispersion Model Version 6.0 software (Ausplume) developed by EPA (Victoria). Ausplume combines the particulate emission factors for the various Project Site activities, meteorological data and local topography to predict the dispersion of dust and other particulate matter. Details of the assessment methodology are presented in full in Heggies (2010).

Particulate Emission Factors

Emission factors utilised within the modelling were generally sourced from the *Emission Estimation Technique Manual for Mining, Version 2.3* (Environment Australia, 2001) and "*Estimation Technique Manual for Mining and Processing of Non-metallic Minerals Version 2.0"* (Environment Australia, 2000).

Meteorological Data

The Air Pollution Model (TAPM) software, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), was used to simulate the meteorology of the area. Data obtained from a private meteorological station owned by Carter Holt Harvey at Oberon (installed and maintained by Ecowise Environmental), located approximately 9km northwest of the Project Site was incorporated into the TAPM simulation.

Local Topography

Heggies (2010) considers there are no significant topographic features which would impede atmospheric dispersion between the Project Site and adjacent residences. Consequently, topography has not been considered in the Ausplume dispersion model although topography has been taken into account when generating the site specific meteorological input files using TAPM.

Modelled Scenarios

Two scenarios have been modelled to reflect typical worst case operations on the Project Site, namely:

- Scenario 1 – extraction operations at or near ground level in the southwestern corner of the proposed extraction area; and
- Scenario 2 – extraction operations at or near ground level in the northwestern corner of the proposed extraction area.

For both scenarios, operations were assumed to be occurring at the maximum production rate of 250 000tpa.

4.8.6 Impact Assessment

4.8.6.1 24-Hour Average PM_{10}

Tables 4.24 to **4.27** presents the Ausplume predicted 24-hour PM_{10} concentration for the five highest predicted maximum 24-hour average PM_{10} concentrations (background plus predicted increment) and the five highest predicted increment concentrations at four surrounding residential receptors surrounding the Project Site. A contour plot of the maximum predicted incremental 24-hour average PM_{10} concentrations for each scenario is also presented in **Figure 4.14**.

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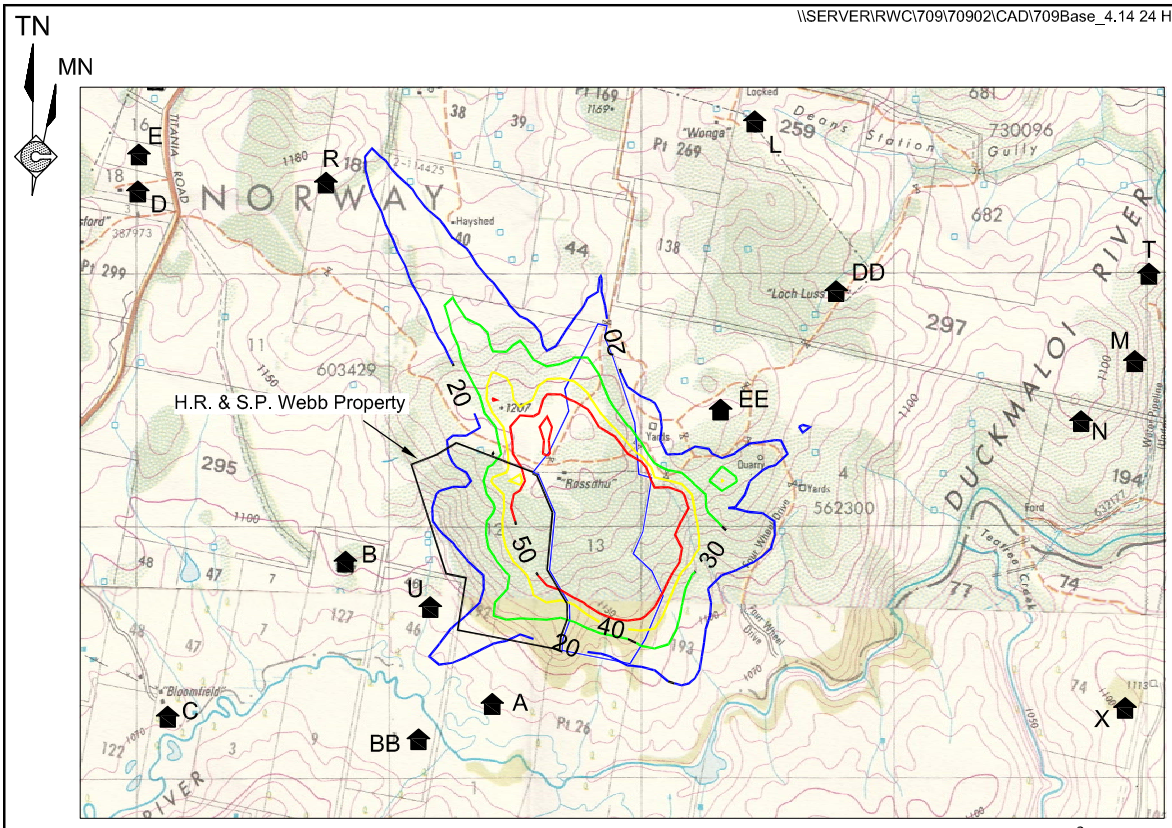
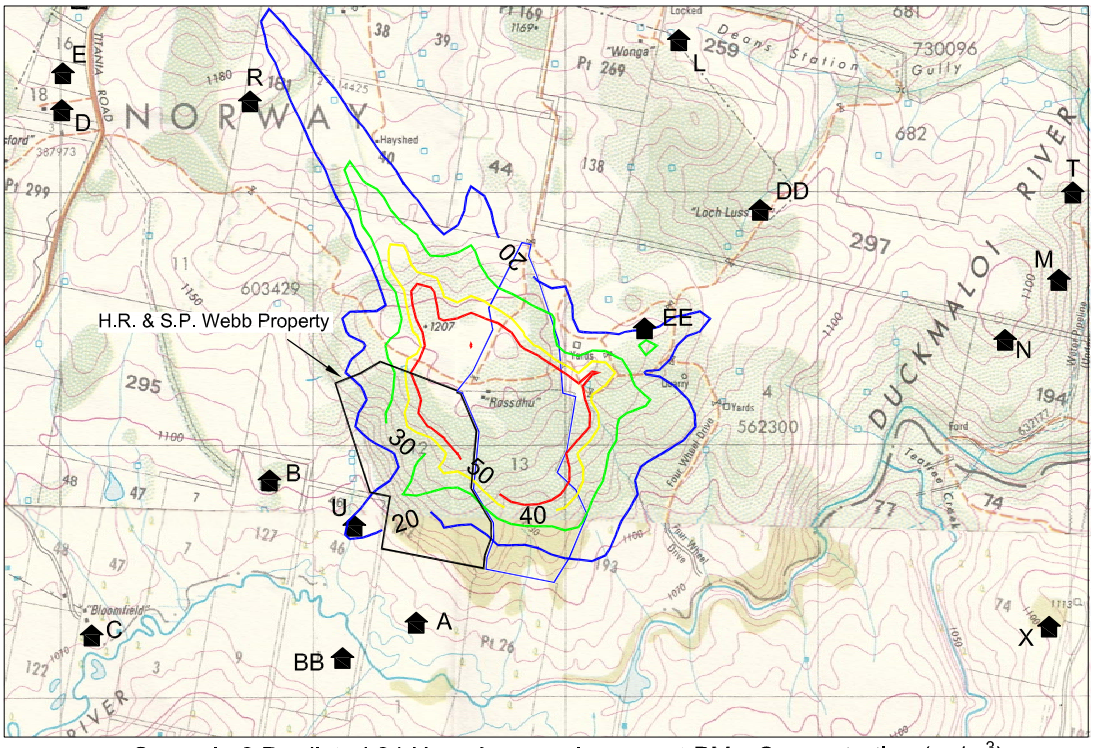


Scenario 1 Predicted 24 Hour Average Increment PM_{10} Concentration (ug/m^3)



Scenario 2 Predicted 24 Hour Average Increment PM_{10} Concentration (ug/m^3)

Figure 4.14
PREDICTED INCREMENTAL
24 - HOUR PM_{10} CONTOURS

Source: Modified after Heggies (2010) - Figures 7 and 8

Table 4.24
24-Hour Average PM_{10} Concentrations at Receptor A

Date	PM_{10} 24-hour average ($\mu g/m^3$)			Date	PM_{10} 24-hour average ($\mu g/m^3$)		
	Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
Scenario 1							
Five Highest Background Levels				**Five Highest Predicted Increments**			
02/10/2007	156.7	0	156.7	4/4/2007	20.7	11.2	31.9
27/01/2007	71.1	0	71.1	25/10/2007	10.1	6.54	16.6
12/01/2007	49.3	0	49.3	20/10/2007	32.7	6.12	38.8
04/05/2007	48.4	0	48.4	22/7/2010	10.4	5.26	15.6
03/10/2007	43.5	0.9	44.4	16/1/2010	25.5	4.68	30.2
Scenario 2							
02/10/2007	156.7	0	156.7	04/04/2007	20.7	10.2	30.9
27/01/2007	71.1	0	71.1	20/10/2007	32.7	4.2	36.8
12/01/2007	49.3	0	49.3	25/10/2007	10.1	4.2	14.2
04/05/2007	48.4	0	48.4	31/07/2007	8.6	3.8	12.3
03/10/2007	43.5	0.9	44.4	23/07/2007	14.9	3.4	18.3
Source: Modified After Heggies (2010) – Table 6							

Table 4.25
24-Hour Average PM_{10} Concentrations at Receptor U

Date	PM_{10} 24-hour average ($\mu g/m^3$)			Date	PM_{10} 24-hour average ($\mu g/m^3$)		
	Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
Scenario 1							
Five Highest Background Levels				**Five Highest Predicted Increments**			
02/10/2007	156.7	0	156.7	18/03/2007	5.6	9.9	15.6
27/01/2007	71.1	0	71.1	02/01/2007	9.8	9.3	19.1
12/01/2007	49.3	0	49.3	06/12/2007	12.4	8.9	21.2
04/05/2007	48.4	0	48.4	17/04/2007	26.8	8.4	35.2
03/10/2007	43.5	0.2	43.7	05/06/2007	12.1	7.5	19.6
Scenario 2							
02/10/2007	156.7	0	156.7	16/08/2007	16.0	22.2	38.2
27/01/2007	71.1	0	71.1	28/05/2007	16.6	7.6	24.2
12/01/2007	49.3	0	49.3	27/04/2007	10.4	7.4	17.8
04/05/2007	48.4	0	48.4	22/07/2007	10.4	6.1	16.4
03/10/2007	43.5	0.3	43.8	24/08/2007	11.4	6.0	17.4
Source: Heggies (2010) – Table 7							

Table 4.26
24-Hour Average PM_{10} Concentrations at Receptor B

Date	PM_{10} 24-hour average ($\mu g/m^3$)			Date	PM_{10} 24-hour average ($\mu g/m^3$)		
	Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
Scenario 1							
Five Height Background Levels				**Five Height Predicted Increments**			
02/10/2007	156.7	0	156.7	10/05/2007	7.8	8.3	16.1
27/01/2007	71.1	0	71.1	08/04/2007	8.0	7.3	15.2
12/01/2007	49.3	0	49.3	26/03/2007	10.8	7.2	17.9
04/05/2007	48.4	0	48.4	19/12/2007	14.6	6.6	21.1
03/10/2007	43.5	0	44.4	27/03/2007	8.9	6.3	15.3
Scenario 2							
02/10/2007	156.7	0	156.7	02/01/2007	9.8	6.5	16.3
27/01/2007	71.1	0	71.1	22/07/2007	10.4	5.9	16.3
12/01/2007	49.3	0	49.3	18/03/2007	5.6	5.6	11.2
04/05/2007	48.4	0	48.4	23/08/2007	8.3	5.1	13.4
03/10/2007	43.5	0	44.4	13/04/2007	23.5	5.1	28.6
Source: Heggies (2010) – Table 8							

Table 4.27
24-Hour Average PM_{10} Concentrations at Receptor EE

Date	PM_{10} 24-hour average ($\mu g/m^3$)			Date	PM_{10} 24-hour average ($\mu g/m^3$)		
	Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
Scenario 1							
Five Height Background Levels				**Five Height Predicted Increments**			
02/10/2007	156.7	0.7	157.4	25/05/2007	11.3	10.9	22.2
27/01/2007	71.1	1.1	72.2	27/02/2007	8.3	7.1	15.3
12/01/2007	49.3	0.3	49.6	15/07/2007	9.7	6.9	16.6
04/05/2007	48.4	0.6	49.0	13/07/2007	5.7	6.9	12.6
03/10/2007	43.5	0.2	43.7	24/05/2007	10.1	6.5	16.6
Scenario 2							
02/10/2007	156.7	1.3	158.0	14/07/2007	6.7	11.9	18.6
27/01/2007	71.1	1.7	72.8	31/05/2007	8.5	10.4	18.9
12/01/2007	49.3	0.3	49.6	12/07/2007	7.1	10.1	17.2
04/05/2007	48.4	1.7	50.1	28/07/2007	6.7	9.8	16.6
03/10/2007	43.5	0.2	43.7	23/05/2007	11.5	9.0	20.5
Source: Heggies (2010) – Table 9							

Tables 4.24 to **Table 4.27** indicate that the predicted 24-hour average PM_{10} concentrations (background plus increment) associated with the Project would present a low risk to contributing to further exceedances of the DECCW PM_{10} criteria of 50µg/m^3 at the nearest sensitive receptors. It is noted that background PM_{10} levels recorded on 27/01/2007 and 02/10/2007 already exceed the DECCW PM_{10} criteria.

A review of the area of privately owned land holding located adjacent the western boundary of the Project Site and the contour plots for Scenario 1 and Scenario 2 (see **Figure 4.14**) indicate that between 15% and 16% respectively of the land area exceeds the Project criteria for 24-hour average PM_{10} . This is below the 25% threshold that the DoP typically mandates.

4.8.6.2 Annual Average PM_{10}

Table 4.28 shows the Ausplume predicted annual average PM_{10} concentration whilst the **Figure 4.15** presents the contour plots for annual average PM_{10}.

Table 4.28
Annual PM_{10} Concentrations at the Nearest Residential Receptors

Receptor[1]	Annual Average PM_{10} Concentration (µg/m^3)		
	Background	Increment	Total (Background + Increment)
Scenario 1			
A	16.0	0.3	16.3
U	16.0	1.0	17.0
B	16.0	1.2	17.2
EE	16.0	1.0	17.0
Scenario 2			
A	16.0	0.3	16.3
U	16.0	0.7	16.7
B	16.0	0.9	16.9
EE	16.0	1.4	17.4

Note 1: See **Figure 4.15**
Source: Heggies (2010) – Table 10

Table 4.28 indicates that the annual average concentration of PM_{10} (background plus incremental) associated with the Project would be well below the Project goal of 30µg/m^3 at all residential receptors. The low incremental results indicate that the operations of the Project Site would lead to no significant increases in annual average PM_{10} concentrations in the local area.

A review of the area of the privately-owned land holding located adjacent the western boundary of the Project Site and the contour plots for Scenario 1 and Scenario 2 (see **Figure 4.15**) indicate that for Scenario 2 approximately 2% of the landholding would experience exceedances of the Project criteria for annual average PM_{10}. Average annual PM_{10} would therefore be well below the 25% threshold that the DoP typically mandates.

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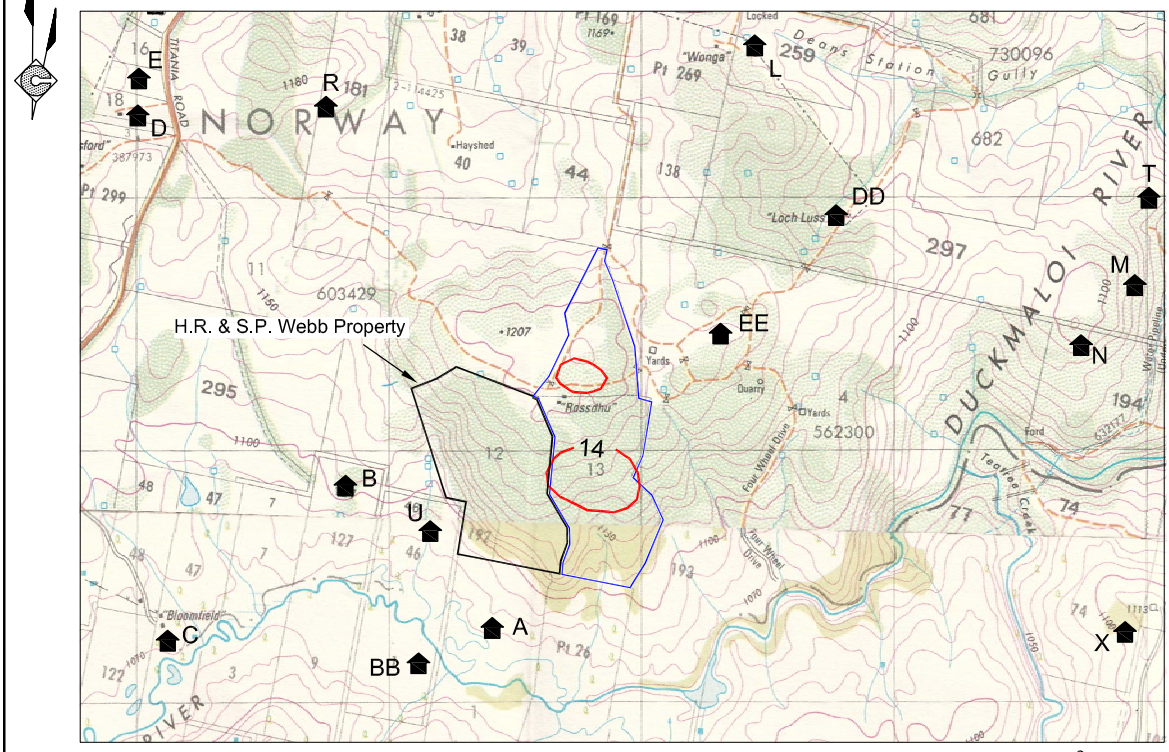
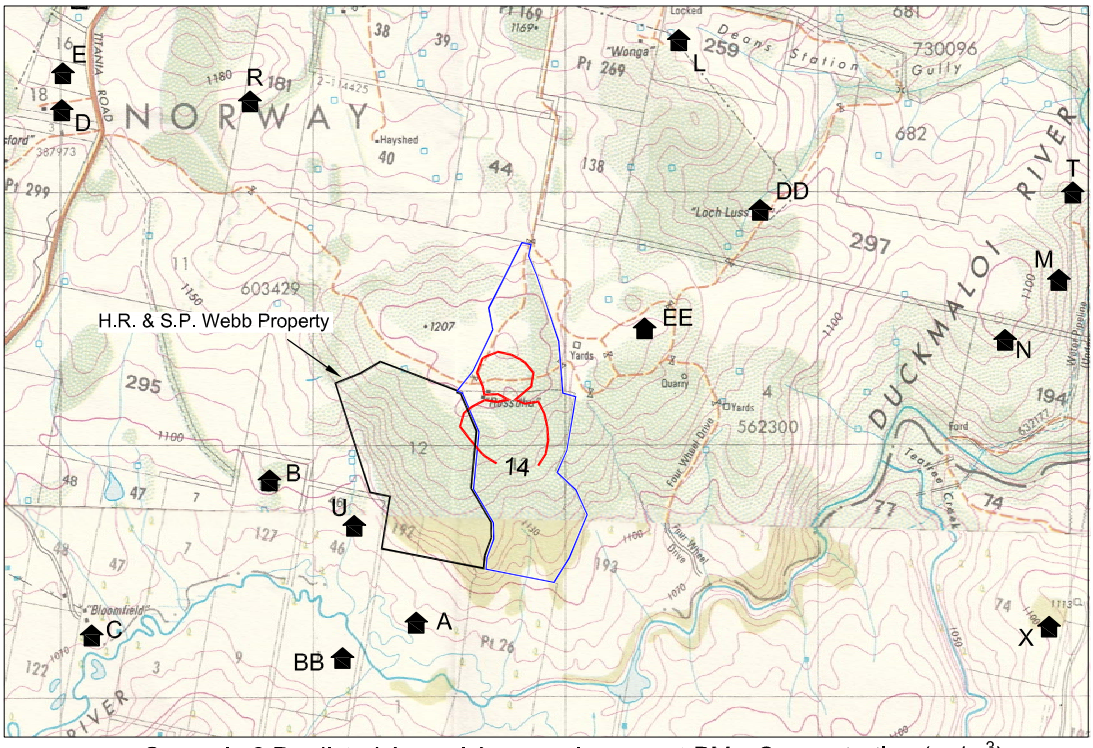


Scenario 1 Predicted Annual Average Increment PM_{10} Concentration (ug/m^3)



Scenario 2 Predicted Annual Average Increment PM_{10} Concentration (ug/m^3)

Figure 4.15
PREDICTED ANNUAL AVERAGE PM_{10} CONTOURS

Source: Modified after Heggies (2010) - Figures 9 and 10

4.8.6.3 Dust Deposition

Table 4.29 presents the results of the Ausplume predictions for dust deposition at the three closest residential receptors whilst the **Figure 4.16** presents the contour plots for the incremental dust deposition.

Table 4.29
Deposited Dust Concentrations at Nearest Residential Receptors

Receptor[1]	Dust Concentration – Annual Average (µg/m^3)		
	Background	Increment	Total (Background + Increment)
Scenario 1			
A	2.0	<0.1	2.1
U	2.0	0.4	2.4
B	2.0	0.5	2.5
EE	2.0	0.5	2.5
Scenario 2			
A	2.0	<0.1	2.1
U	2.0	0.3	2.3
B	2.0	0.4	2.4
EE	2.0	0.6	2.6

Source: Heggies (2010) – Table 11
Note 1: See **Figure 4.16**

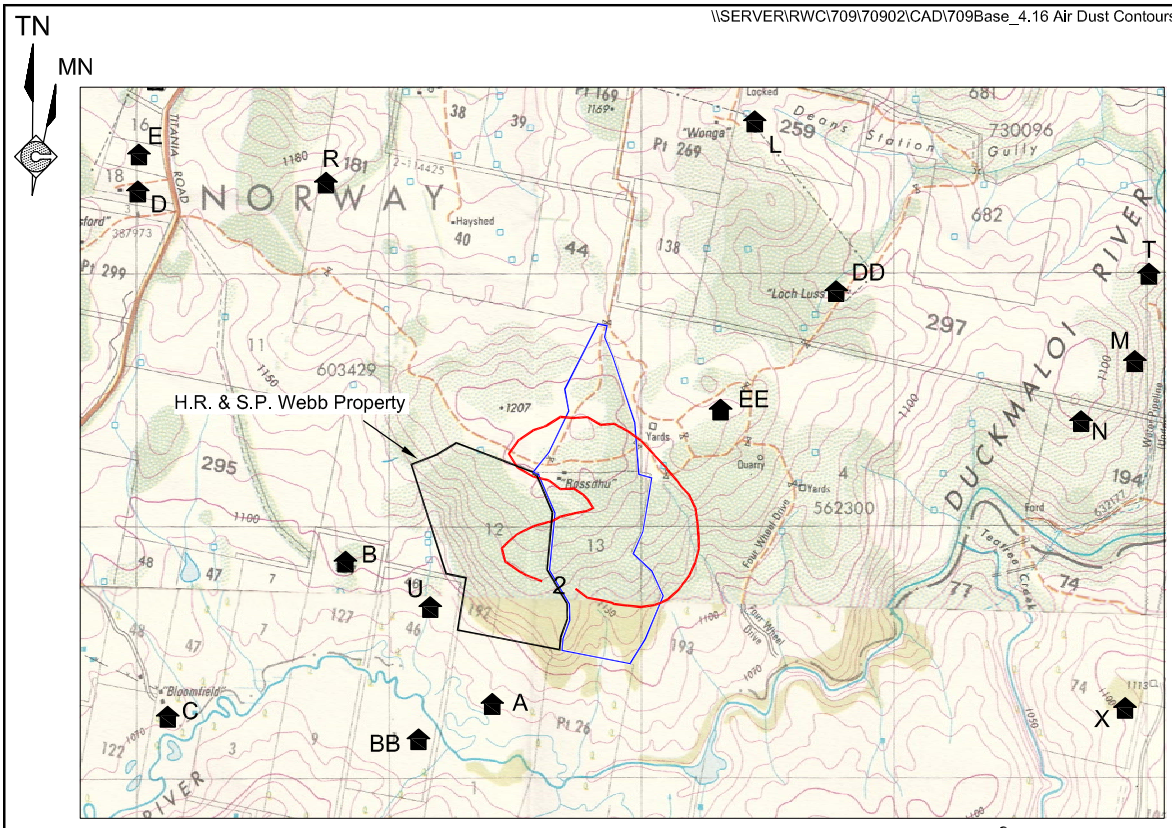
The results indicate that the annual average monthly dust deposition (background plus incremental) rates associated with the Project are predicted to be below the Project dust deposition goal of 4g/m^2/month (background plus increment) for all receptors in both scenarios. In addition, the incremental increase in dust deposition is predicted to be below the NSW DECCW allowable increase of 2g/m^2/month at all receptors.

A review of the area of privately owned land holding located adjacent the western boundary of the Project Site and the contour plots for Scenario 1 and Scenario 2 (see **Figure 4.16**) indicate that 11% and 19% respectively of the privately owned land is exceeding the Project criteria for Dust Deposition. This is below the 25% threshold that the DoP typically mandates.

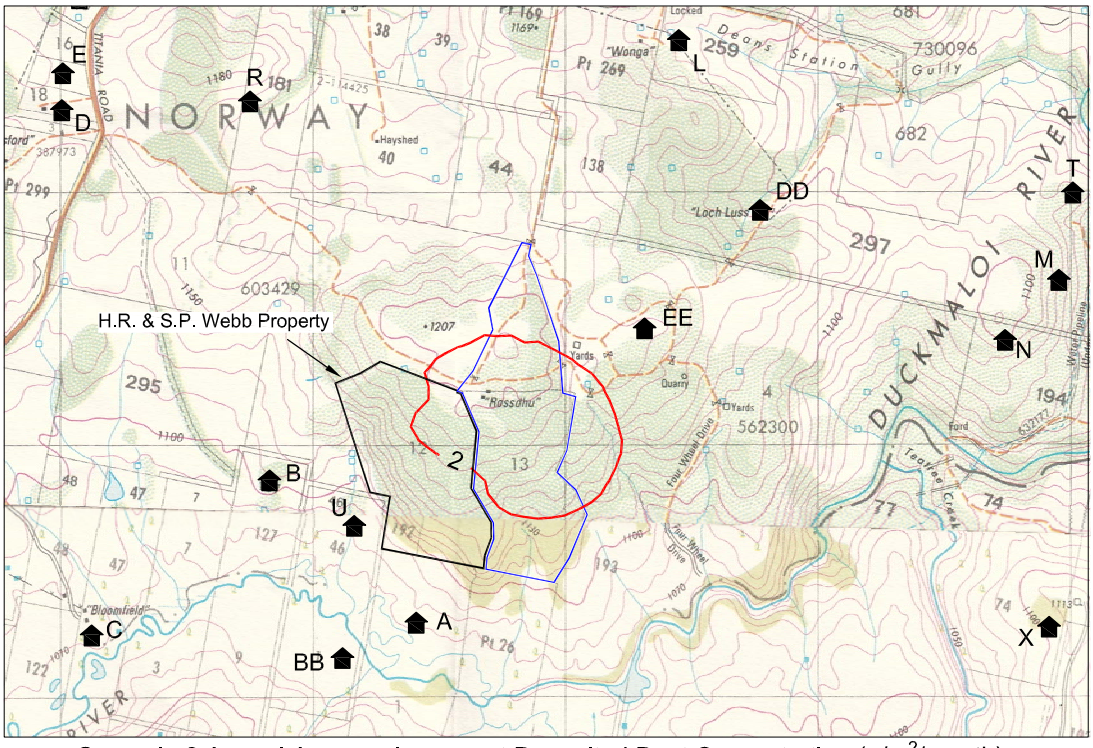
4.8.6.4 Greenhouse Gases

A full life cycle assessment of worst case annual greenhouse gas emissions from the Project has been conducted and is detailed in full in Heggies (2010). The results of this assessment indicate that the maximum annual emissions of CO_2-Equivalent as a result of the operations at the Project are predicted to be of the order of 340 t of CO_2-Equivalent per annum. Over the Project lifetime of 30 years, emissions of CO_2-Equivalent are estimated to be in the order of 10 192 t. When compared with each unit of production, emissions of CO_2-Equivalent are estimated to be in the order of 0.001t/t granite.

\\SERVER\RWC\709\70902\CAD\709Base_4.16 Air Dust Contours.DWG



Scenario 1 Annual Average Increment Deposited Dust Concentration (g/m^2/month)



Scenario 2 Annual Average Increment Deposited Dust Concentration (g/m^2/month)

Figure 4.16
PREDICTED DUST DEPOSITION CONTOURS

Source: Modified after Heggies (2010) - Figures 11 and 12

Greenhouse gas estimates are assessed relative to 1990 baseline levels for reporting purposes. The AGO (AGO, 2006) estimates that in 1990, Australian greenhouse gas emissions totalled 551.9 Mt CO_2-equivalent. A comparison of the predicted emissions with the 1990 national estimate demonstrates that operations would represent an annual increase of approximately 0.00006 % of the total baseline Australian emissions.

Emissions of greenhouse gases in NSW during 2005 amounted to a total of 158.2 Mt CO_2-equivalent (AGO, 2007). A comparison of the predicted emissions due to the proposed operations with NSW emissions in 2005 demonstrates that operations would represent an annual increase of approximately 0.002 %.

4.8.7 Monitoring

Monitoring of deposited dust levels would be undertaken at two or three locations surrounding the Project Site for a period of 5 years following commencement of operations. The location of the monitoring sites would be determined in consultation with the DECCW and surrounding landholders. Following the initial 5 years of operation, the need for ongoing dust monitoring would be reviewed in consultation with DECCW. All deposited dust monitoring results would be reported within each Annual Environmental Management Report.

4.8.8 Conclusion

Using the Ausplume (version 6.0) modelling system, Heggies (2010) predict that total deposited dust and annual PM_{10} levels at surrounding residences and the H.R. & S.P. Webb landholding would remain below accepted criteria. Additionally, no exceedances of maximum 24hr PM_{10} concentrations were considered likely to occur at surrounding residences and the H.R. & S.P. Webb landholding (beyond those already occurring within the background data).

Greenhouse gas estimates were also undertaken in accordance with relevant guidelines and policies. It is considered that the proposed operations would result in a comparatively small contribution to greenhouse gas emissions when compared with reported State and National baselines.

4.9 ABORIGINAL CULTURAL HERITAGE

4.9.1 Introduction

An Aboriginal heritage assessment was conducted by Archaeological Surveys and Reports (ASR) in conjunction with identified Aboriginal stakeholders. The assessment report is summarised in the following subsections and is presented in full in Part 6 of the *Specialist Consultant Studies Compendium.*

The objective of the assessment was to:

- describe the archaeological investigation of the Project Site;
- record any archaeological relics found as part of the assessment and survey of the Project Site;

- undertake consultation and involvement of Aboriginal stakeholders in accordance with the 'Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation' (DECC 2005);
- identify from the results of the assessment and survey any potential constraints on cultural grounds to the Project; and
- make recommendations for any impact mitigation strategies, or Management Plans that may be needed for the avoidance, conservation or preservation of Aboriginal cultural heritage value identified within the Project Site as a result of the assessment.

4.9.2 Assessment Methodology

The Aboriginal heritage assessment was undertaken in the following stages.

- Stage 1 – Aboriginal Consultation

  Prior to the investigation, consultation was conducted in accordance with the 'Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation' (DECC 2005). This included placing and advertisement in the local newspaper inviting all Aboriginal stakeholders with an interest in the project to register as well as writing to all identified Aboriginal stakeholders advising that fieldwork in the Study Area would commence shortly.

- Stage 2 – Background Research

  As part of the background research for the assessment, a search of the DECCW AHIMS register was undertaken. A previous survey of the area was also reviewed as well as data relating to geology, topography, vegetation, water resources, stone resources and previous impacts across the Project Site.

- Stage 3 – Predictive Modelling

  Based on the background information and experience of the archaeologist, a predictive model was developed to predict the probability of encountering items of significance in different areas of the Project Site.

- Stage 4 – Field Survey

  A field inspection and survey was undertaken on 3 April 2009 by ASR and representatives from the Bathurst Wiradjuri and the Dhuuluu-Yala Yarranack Enterprises.

- Stage 5 – Assessment of Results

  The results of the field survey were assessed by taking into account various factors including surface visibility, survey intensity and survey approaches.

4.9.3 Previous Investigations and Aboriginal Sites Register Search

Pejar Local Aboriginal Land Council (LALC) undertook a survey which included the Project Site in November 2006. This survey was conducted without the participation of a qualified archaeologist or representatives of any other Aboriginal organisation. No Aboriginal sites were found during this survey.

No Aboriginal sites within the Project Site were identified as a result of the AHIMS search. In the general area which included the Project Site, only one site was listed (#44-6-0008 – Bora ground, 'Oberon, Kings Stockyard Creek'), but is located some distance from the Project Site.

4.9.4 Survey Results

No sites or places of archaeological or Indigenous cultural significance or locations of Potential Archaeological Deposits (PADs) were identified within the Project Site as a result of the field survey conducted on 3 April 2009.

4.9.5 Mitigation and Management Procedures

In the absence of any sites or places of Aboriginal cultural significance, there is no requirement for any impact mitigation strategies, or for a Management Plan for the avoidance, conservation or preservation of Aboriginal cultural heritage value for the Project.

4.9.6 Safeguards

The Proponent is aware of its obligations under the *National Parks and Wildlife Act, 1974* (as amended). Should any relic be uncovered during ground disturbing activities, work at the site of the relic and in the area immediately surrounding the relic would cease and the DECCW, Pejar LALC, Bathurst Wiradjuri and Dhuuluu-Yala Yarranack Enterprises and the Police (if bone material is discovered that cannot be clearly identified as animal remains by a qualified archaeologist) would be informed of the find. Work would not recommence in the area immediately surrounding the find until those officials have inspected the material and permission has been given to resume activities.

4.9.7 Assessment of Impacts

As no sites of Aboriginal cultural or archaeological significance or places of potential research significance were identified within the project site as a result of this survey, it is concluded there will be no Aboriginal heritage issues that would present a constraint to the proposal.

4.10 EUROPEAN HERITAGE

A search of the Australian Heritage Database, the NSW State Heritage Register, the NSW State Heritage Inventory and the Oberon LEP was conducted on 05 November 2010. No items of European heritage significance were identified within or surrounding the Project Site. Therefore no specific safeguard or management measures are deemed necessary and no impacts upon European heritage are anticipated.

4.11 VISIBILITY

4.11.1 Introduction

As part of the consultation process, a number of local residents and landowners identified impacts on their visual amenity as an issue of concern. The Director-General's Requirements also identified visual impacts as a key issue for assessment. Based on the environmental risk analysis undertaken for the Project (see Section 3.3 and **Table 3.7**), the **unmitigated** risk rating for potential impacts on visual amenity was considered high for the short to medium term and moderate for the long term. It is noted that this risk rating only relates to the potentially most affected residences / landholdings with most Project activities not visible from the majority of surrounding residences / landholdings.

This subsection outlines the existing visual amenity and views of the Project Site experienced by surrounding residents / landowners, proposed safeguards and mitigation measures and an assessment of the likely impact(s) to the visual amenity.

4.11.2 Existing Visual Amenity

The existing visual character of the Project Site and surrounds is a combination of a rural landscape including rural residential, grazing, limited horticultural enterprises and native vegetation. It is noted that some areas of the landscape are rocky with naturally exposed rock evident on properties adjoining the Project Site.

Plates 4.4 to **4.8** show the current views from the extraction area and from surrounding areas towards the extraction area.

Plate 4.4 View southwards from the northern boundary of the existing extraction area. (Ref: E709E-008 and 009)

For assessment purposes, views of the Project Site may be separated into the following visual catchments.

- Close distance, low elevation views from properties immediately surrounding the Project Site to the east, west and northwest. Currently the road within the right of carriageway and the existing storage sheds are visible from some areas within these locations.

- Medium to long distance, low and high elevation views from properties to the south of the Project Site (see **Figure 4.17**). Currently, the existing extraction area is visible to varying extents from these properties.

Views of the Project Site from the southeast and southwest are essentially nil due to the intervening topography and vegetation.

4.11.3 Mitigation Measures and Management Procedures

The following visual controls would be implemented to reduce potential adverse impacts upon visual amenity.

- The office, amenities and stockpiling area are located so as to provide visual shielding from the surrounding topography and existing vegetation.
- A visual screen would be planted along the right of carriageway (see **Figure 2.1**) to supplement existing vegetation and reduce potential views of stockpiling and transport activities.
- The Project Site would be progressively rehabilitated so that non-vegetated areas would be minimised.
- The Project Site would be maintained in a clean and tidy condition at all times.
- Air quality controls would be implemented (see Section 4.7.4) to reduce visible dust.
- Any lighting required would be positioned and directed so as to minimise light emissions. Where lighting is not required at any given time, it would not be used.

It is noted that, as the floor of the extraction area is not visible, the principal purpose of the 6m amenity bund is for acoustic purposes, rather than visibility.

In addition to these measures, trials would also be undertaken, in consultation with potentially affected landholders to the south, to establish the most effective and practical technique to reduce the visual impact of the finalised upper quarry faces prior to the establishment of vegetation. Methods that would be investigated would include, but not be limited to:

- use of shade cloth, hessian material or other material to hang across the final face; and
- painting of the final face.

It is recognised that these techniques would need to be trialled to assess their effectiveness and that a combination of methods may provide the most effective means to reduce the potential visual impact of the final quarry faces prior to establishment of vegetation on the final quarry benches.

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Plate 4.5: View northwards from Burroughs Crossing Road
(See Figure 4.17)
(Ref: E709F/029)

Plate 4.6: View northwards from Burroughs Crossing Road
(See Figure 4.17)
(Ref: E709F/031)

Plate 4.7: View northwards from McKeons Creek Road
(See Figure 4.17)
(Ref: E709F/034)

Plate 4.8: View north-northwestwards from McKeons Creek Road
(See Figure 4.17)
(Ref: E709F/036)

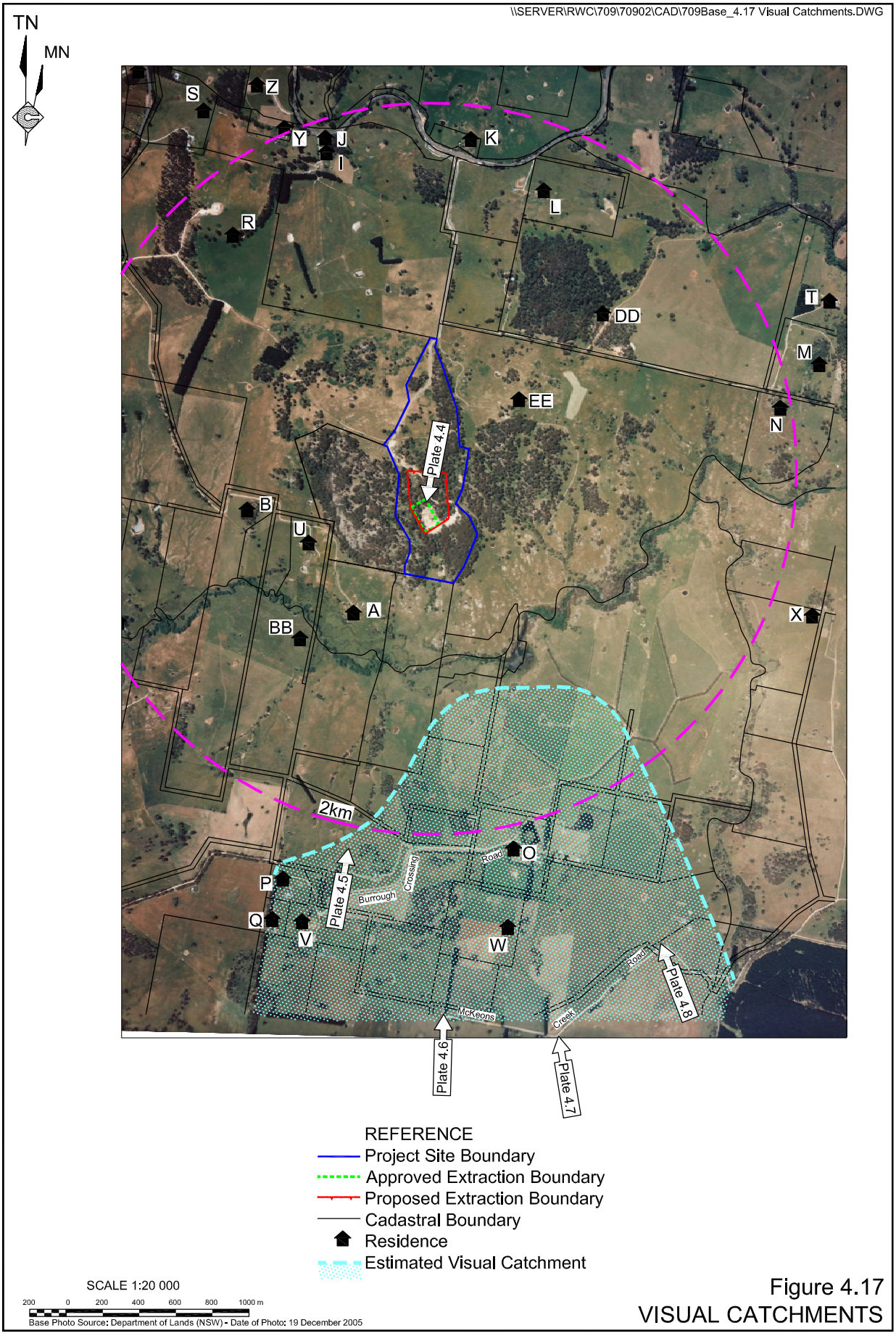

Figure 4.17
VISUAL CATCHMENTS

4.11.4 Residual Impacts

Based upon the available topographic information, observations from surrounding vantage points and the proposed mitigation measures, residual visual impacts have been assessed as follows.

- Close distance, low elevation views from properties immediately surrounding the Project Site to the east, west and northwest.

  The existing shielding provided by the intervening topography and vegetation and the additional shielding that would be provided by the proposed tree screening would effectively minimise the potential visual impacts from on-site activities. Within the Project Site, the extraction area and office, amenities and stockpiling areas would be effectively screened and would not be visible from any surrounding residences.

- Medium to long distance, low and high elevation views from properties to the south of the Project Site.

  The extraction area would continue to be visible from several landholdings and residences to the south. As extraction progresses to the north of the proposed extraction area, the elevation of the disturbed area would increase from approximately 1 170m AHD to 1 190m AHD resulting in up to an additional 20m vertical exposure of quarry faces compared with the existing faces. This additional 20m represents an increase in visible angle of only 0.57° over a distance of 2km and 0.29° over a distance of 4km.

  With the implementation of mitigation measures discussed in Section 4.12.3, the level of visual intrusion would be greatly minimised, particularly following finalisation of each quarry bench.

Following completion of rehabilitation, it is considered that the Project would result in minimal ongoing visual intrusion and that the visual character of the Project Site would be returned to a state similar to the naturally occurring landscape in the area.

4.12 SOCIAL ISSUES

4.12.1 Existing Socio-economic Setting

The socio-economic setting around the Project Site is described in this subsection to provide an overview of the interaction between the local and wider community and the proposed operations.

The Project Site is located within Oberon Local Government Area (LGA), approximately 6km east-southeast of the Oberon township.

As at the August 2006 Census, the estimated population within the Oberon LGA (which covers an area of approximately 3 626.6km^2) was approximately 5 030 (ABS, 2007), whilst the median household size was 2.6 persons per household. The Project Site is located within Collection District 1142013 which covers an area of approximately 132.7km^2 which recorded a population of 320 persons with a median household size of 2.9.

The four main industries in which people are employed in Oberon LGA are Manufacturing (22%), Agriculture, Forestry and Fishing (18%), Retail (7%) and Accommodation and Food Services (7%). The principal industry in which people are employed within Collection District 1142013 is Manufacturing (14%), Accommodation and Food Services (10%) and Education and Training (10%). The unemployment rate within the Oberon LGA and Collection District 1142013 in 2006 was approximately 4.6% and 6.2% respectively. The median individual weekly income throughout Oberon LGA and Collection District 1142013 was $436 and $451 respectively.

4.12.2 Safeguards

In addition to the mitigation measures and management procedures relating to amenity aspects such as noise, air quality, visibility, transportation etc., described previously in Section 4, the Proponent would implement the following management and mitigation measures to ensure that Project-related benefits for the community surrounding the Project Site are maximised and adverse impacts are minimised.

- Proactively consult throughout the Project life with those residents who could potentially be adversely impacted by the Project.
- Participation in a Community Consultative Committee should there be interest from the community.
- Continue to engage the community surrounding the Project through the use of an "open door" policy for any member of the community who wishes to discuss any aspect of the Project.
- Maintenance of a community complaints response system.
- Continued preference, where practicable, to suppliers of equipment, services or consumables located within the local community.

4.12.3 Assessment of Impacts

The Project would result in a range of socio-economic benefits to the local and wider community including the following.

- Direct employment (full-time equivalent) for approximately 6 to 10 people on site and 15 to 20 truck drivers.
- Direct injection of approximately $500 000 to $750 000 annually into the local and regional economy through payment of wages to on site personnel and purchase of consumables etc. A further approximately $600 000 in annual wages would also paid through the generation of employment for product truck drivers.
- Continued positive support and involvement in the local community.

In relation to negative social impacts, although a number of surrounding residents would become aware of the proposed operations, potential impacts related to visibility, noise, air quality and increased traffic levels would be managed to minimise adverse effects on existing amenity levels.

In relation to potential land use conflicts, as the Project would be operated so as to minimise adverse impacts upon amenity, it is considered that any land use conflicts relating to amenity could be appropriately managed. Furthermore, it has been demonstrated at similar quarrying and mining operations that activities such as those proposed can occur harmoniously with the existing surrounding agricultural land uses.

It is noted that the Proponent has previously approach surrounding landholders to purchase all or part of their landholding in order to increase the buffer area around the proposed operations. Although these offers have not been accepted, the Proponent would continue to consider purchase of land to increase their buffer to surrounding land uses.

Given the Proponent's intention to operate the Project for the long-term, the Proponent is committed to ongoing community consultation with surrounding residents to ensure that any concerns of the surrounding residents are addressed and they are kept informed about the operations.

It is also acknowledged that two surrounding landowners raised concerns relating to potential decreases in property values. Based upon experience around other mining and quarrying projects, there may be a perceived decrease in property values in the short term. However, following a comparatively short period after which the Proponent demonstrates the effectiveness of the proposed safeguards, it is deemed that the perceived decrease in property values would substantially lessen and, considering the presence of the existing quarry operations, property values should not be significantly affected.

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